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CHEMICAL QUALITY OF WATER OF ALABAMA STREAMS, 1960

A Reconnaissance Study

By Rodney N. Cherry

GEOLOGICAL SURVEY OF ALABAMA

INFORMATION SERIES 27

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GEOLOGICAL SURVEY OF ALABAMA

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INFORMATION SERIES 27

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ALABAMA STREAMS, 1960
A Reconnaissance Study**

By Rodney N. Cherry

**Prepared by the United States Geological Survey
in cooperation with the
Geological Survey of Alabama**

UNIVERSITY, ALABAMA

1963

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*Intermittent employment only.

University, Alabama
February 15, 1963

Honorable George C. Wallace
Governor of Alabama
Montgomery, Alabama

Dear Governor Wallace:

I have the honor to transmit the manuscript of a report entitled "Chemical Quality of Water of Alabama Streams, 1960, A Reconnaissance," by Rodney N. Cherry of the United States Geological Survey, with the request that it be printed as Information Series 27 of the Geological Survey of Alabama.

The surface waters of Alabama are one of the State's most valuable natural resources. This report describes the results of a reconnaissance study of the chemical quality of water of Alabama's streams. The dissolved mineral content in water from most of the streams was less than 200 parts per million, but, locally, the hardness of water may be objectionable.

Respectfully,


Philip E. LaMoreaux
State Geologist

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CHEMICAL QUALITY OF WATER OF ALABAMA STREAMS, 1960

A Reconnaissance Study

By Rodney N. Cherry

ABSTRACT

This report presents the finding of a reconnaissance of the quality of surface streams in the State of Alabama during 1960.

The chemical quality of Alabama streams is good. The mineral content in more than 90 percent of the streams is less than 200 ppm. Hardness is perhaps the most objectionable feature of water quality. Some waters in the State exceed 120 ppm hardness.

Generally, the chemical characteristics of the water in the streams are related to natural conditions. Differences in the chemical characteristics between areas of the State are due chiefly to differences in rock type, whereas differences in chemical characteristics within areas are related to rainfall.

INTRODUCTION

"Rainfall, ground water, rivers, lakes, oceans, and atmospheric moisture constitute an inexhaustible supply of water. It is indispensable to life, but whether or not this moving supply is made to serve mankind adequately is a question of control and management of regional and local supplies." (Allen, 1959, p. 3).

The progress of any area may well depend on the quality and quantity of its water supply. Of all the natural resources that any state or area may need, water is used in greater quantities than any other material. Not only must the water be in sufficient quantity, but it also must be of usable quality. Water quality requirements vary widely, depending on how the water is to be used. Every use requires water equal to or better than a minimum standard. Sea water, for instance, is not usable for drinking because of the high concentration of mineral constituents dissolved in the water; on the other hand, sea water can be used for cooling.

The expenditure of vast sums of money is required to provide corrective measures to cure or alleviate certain conditions brought about by unwise use of a water resource. Frequently the cost of these corrective measures might have been substantially reduced or, better still, the unwise use of the water resource might have been avoided had the nature of the water resource been more clearly understood.

One of the first steps in any systematic study of the quality of water of a state is to appraise or inventory the quality of water in the streams. Realizing the importance of the quality of water to the welfare of the people and to future industrial development, the State of Alabama in 1959 initiated a study of stream water quality.

The purpose of this study was to obtain current quality of water data and a knowledge of the determining factors. The results of this study are to provide a basis for determining the need for and nature of future investigations of water quality. The scope of this investigation was to obtain only a knowledge of general conditions. More detailed studies will be required to define adequately the quality of water.

Investigations of water quality have been made by the Tennessee Valley Authority (1948 and 1957) and the Alabama Water Improvement Commission(1949). The latter report was used extensively in preparing this report.

Program Description

The data in this study were collected during two surveys, April 25-May 2, 1960, and August 28-September 4, 1960. Data-collection points were selected, using the available quality data, geologic maps, topographic maps, and stream location maps. A comprehensive analysis was made on most of the samples collected from these points. The constituents determined in the comprehensive analysis were: silica, iron, calcium, hardness, sodium and potassium, bicarbonate, sulfate, chloride, fluoride, nitrate, color, pH, and dissolved solids. Additional samples for partial analysis were collected in the general vicinity from which the samples for comprehensive analysis were collected. The constituents determined in the partial analysis were: hardness, sodium, potassium, bicarbonate, color, and pH. These partial analyses were used to supplement the data obtained from the comprehensive analyses and permitted a more extensive coverage with fewer complete analyses.

The boundaries of areas having similar water were defined primarily from data collected during the August-September survey. In general, "average flow conditions prevailed during the April-May survey and

low flow prevailed, August-September survey."--written communication, Lamar Carroon, district engineer, Surface Water Branch, University, Alabama, December 18, 1961. During periods of high stream-flow, mineral content of water in all areas of the State would be lower; some waters would take on the characteristics of rainwater, and differences in the characteristics of water from the various areas would not be readily apparent.

Plate 1 shows the location of the data-collection points used during this study.

The samples collected during this study were analyzed according to methods regularly used by the Geological Survey. These methods are the same as, or are modifications of, methods described in recognized authoritative publications for the mineral analysis of water samples (Rainwater and Thatcher, 1960).

The number of observations made during this study is small in relation to the number needed to give a complete and detailed appraisal of water quality. However, the intent of any reconnaissance is to evaluate the general level of quality and to provide information about variations in composition or quality over an area. The overall treatment of the data is generalized--trends or anomalies are pointed out wherever possible and an attempt is made to explain them.

This report is divided into three major sections. The first section deals with some of the individual chemical characteristics and shows where water with a certain characteristic may be found. The second section presents some of the characteristics of chemical quality within rather large areas. The emphasis in this section is on characteristics that are similar due to similar environment. The third section discusses characteristics and similarities and changes of the chemical quality of the major rivers and their tributaries. An attempt is made to relate changes in the river water quality to the quality of inflow from the various areas defined in the second section of the report.

Table 10 contains the data collected during this study. The streams are listed in downstream sequence.

Acknowledgments

This study was conducted by the U. S. Geological Survey in cooperation with the Geological Survey of Alabama, Dr. Walter B. Jones, state geologist, succeeded by Philip E. LaMoreaux.

Other offices in the U. S. Geological Survey provided special help: The Surface Water Branch, Montgomery, Lamar Carroon, district engineer; the Surface Water Branch, Chattanooga, Tenn., Joseph E. Cragwall, Jr., district engineer; and the Surface Water Branch, Ocala, Fla., A. O. Patterson, district engineer, all furnished streamflow records. The Ground Water Branch, Tuscaloosa, Ala., W. J. Powell, district geologist, furnished information on the geology of the State.

This report was prepared under the supervision of J. W. Geurin, district chemist, succeeded by K. A. MacKichan, district engineer, with assistance by B. F. Joyner, assistant district engineer. Special thanks go to Rodney Grantham, Don Shattles, and Don Meyers of the Ocala district for their assistance in collecting the water samples.

Several reports on the surface-water resources of Alabama have been prepared by the U. S. Geological Survey in cooperation with the Geological Survey of Alabama, including: "Water Resources and Hydrology of Southeastern Alabama," by R. W. Carter and others; "Hydrology and Surface-Water Resources of East-Central Alabama," by L. B. Peirce and Eugene Brown; "Surface-Water Resources and Hydrology of West-Central Alabama," by L. B. Peirce and J. W. Geurin; and "Floods in Alabama, Magnitude and Frequency," by L. B. Peirce. Material from these reports has been used extensively in preparing this report. Information on geology was obtained chiefly from "Geology of Alabama," by G. I. Adams and others.

Description of State

Alabama has an area of approximately 51,000 square miles. From north to south its length is about 300 miles and from east to west its greatest width is about 200 miles. Altitudes range from sea level in the southwestern part of the State to 2,407 feet at Mt. Cheaha in east-central Alabama.

Alabama is a humid state. In an average year, precipitation is equivalent to a volume of water about 55 inches deep spread over the entire State. The average annual precipitation is greatest, about 65 inches, in the coastal area and least, about 50 inches, in the south-central part of the State.

Alabama lies in five physiographic provinces (U. S. Geol. Survey, 1946): Highland Rim section of the Interior Low Plateaus province, Cumberland Plateau section of the Appalachian Plateaus province, Tennessee section of the Valley and Ridge province, Piedmont Upland section of the Piedmont province, and the East Gulf Coastal Plain section of the

Coastal Plain province (fig. 1).

The following brief description is taken from work done by Fenneman (1938) and Harper (1913) and summarized by Peirce (1954).

Highland Rim Section

The Highland Rim section of the Interior Low Plateaus province is a rolling upland. Most of the streams draining this area are in the Tennessee River basin. Steep cliffs are found along the edges of the tributaries to the Tennessee River. Many streams in this area receive much of their water from springs, particularly during the period of little or no rainfall. The average annual rainfall in this area is about 50 inches.

Cumberland Plateau Section

The Cumberland Plateau section of the Appalachian Plateaus province slopes uniformly southward from altitudes of about 1,800 feet along the northern boundary of the State to an altitude of about 500 feet along the boundary of the Coastal Plain. Broad flat-topped mountains such as Lookout Mountain and Sand Mountain are located in this area. Many of the streams in this area have steep-sided and gorgelike valleys. The Black Warrior River and its tributaries drain most of this province. Rocks underlying the area consist chiefly of shales and sandstones.

The average annual precipitation for this area is about 54 inches.

Tennessee Section

The Tennessee section of the Valley and Ridge province is distinguished by a series of parallel ridges and valleys, all having a northeasterly trend. The valleys range in altitudes from 500 to 900 feet and the ridges from 1,000 to 1,500 feet above sea level. The largest of these valleys is the Coosa Valley, a broad valley of low relief. The rocks of this province are chiefly sandstones, limestones, and shales.

The average annual precipitation for this province is about 53 inches.

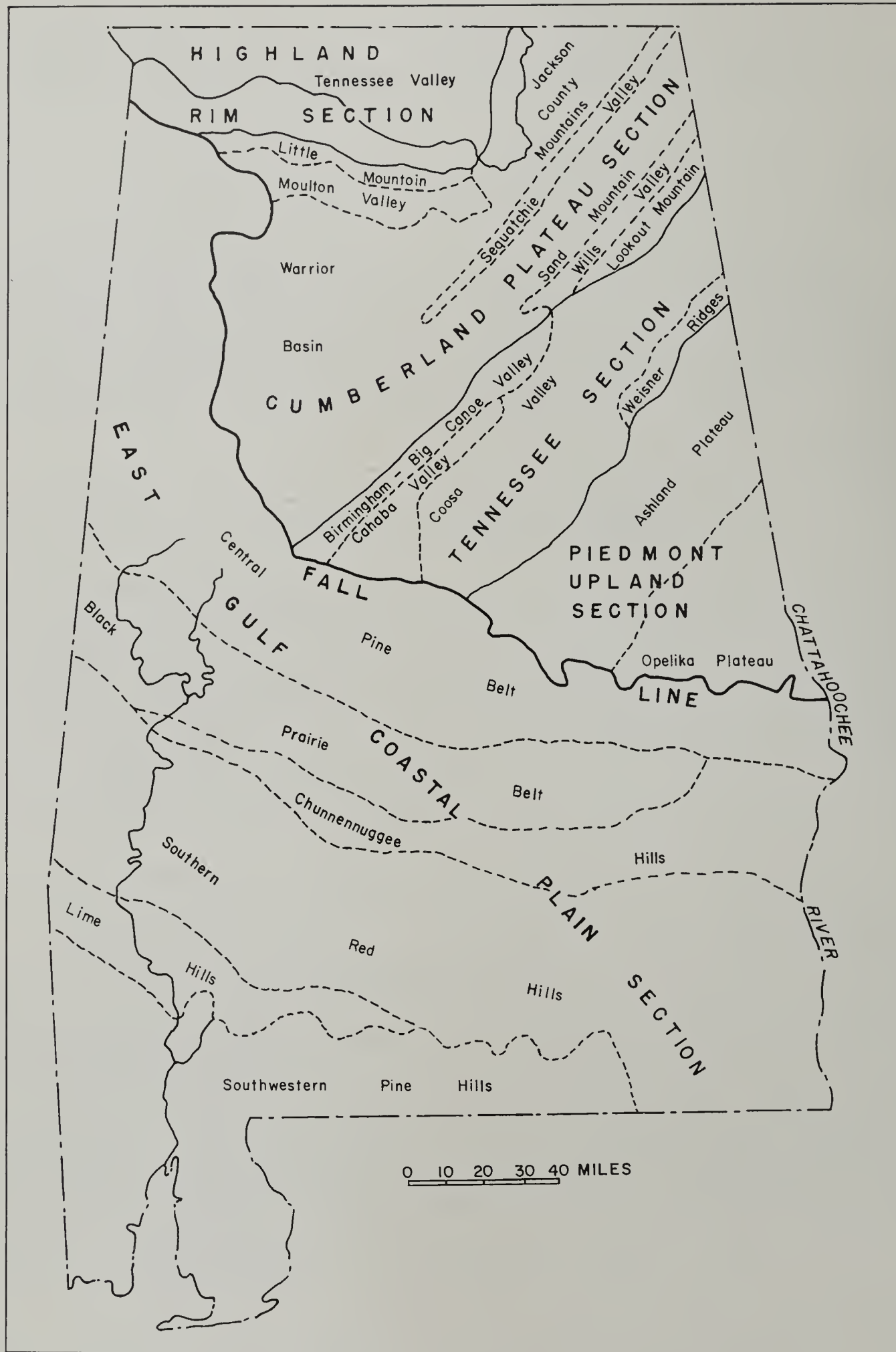


Figure 1. --Map showing the physical divisions of Alabama.

Piedmont Upland Section

The Piedmont Upland section of the Piedmont province is underlain by crystalline rocks. The northwestern part of this province is mountainous. Mt. Cheaha, the highest point in the State, 2,407 feet, is located in this area.

The southeastern part of this province ranges in elevation from 700 to 1,000 feet above sea level and is drained by tributaries of the Tallapoosa and Chattahoochee Rivers. Many streams in this province have cut into the bed rocks to depths as great as 200 feet.

The average annual rainfall is about 53 inches.

East Gulf Coastal Plain Section

The East Gulf Coastal Plain section of the Coastal Plain province is characterized by a series of hilly belts crossing the State in a southeasterly direction. Part of this area is underlain by permeable sands and gravels. These sands and gravels have excellent water-bearing properties. Streams draining areas underlain by chinks and marl have very little dry season inflow. In southwest Alabama, in and around Mobile County, the hills tend to be smooth. The highest of these hills reach altitudes of 350 feet above sea level.

The average annual rainfall for this area ranges from about 65 inches in and around Mobile County to about 56 inches in the rest of the area.

Factors Affecting Quality of Water

The quality of water is determined by the environment through which the water has passed. Among the factors that influence the quality of surface waters are rainfall, rock type, time of contact, biologic conditions, and cultural influences. These factors are not constant with respect to time and location, and a change in any one usually causes a change in the quality of the water.

Rainfall

The source of nearly all surface waters in Alabama is precipitation entering the stream either as direct runoff or as ground-water seepage that has percolated through the soils and rocks to the water table. Rain-

fall reaches the earth in a relatively pure state; however, some substances such as dissolved gases, mineral matter, and dust particles may be dissolved or entrapped in the rain. In coastal areas dissolved mineral matter of several parts per million may be carried inland from the ocean by prevailing winds; the amount decreases with greater distances from the coast. Also rain may become polluted by smoke and gases in industrialized areas. Consequently, part of the dissolved mineral matter in surface waters is carried in directly by rainfall.

As soon as the water reaches the earth's surface it begins to react with the soils and rocks to dissolve mineral matter and, at times, to transport materials as sediment. Carbon dioxide dissolved in rainwater aids in the solution of materials from the earth's crust. Even though dissolved mineral matter is added to the stream systems by rainfall and overland flow, the net effect is usually a dilution of the surface waters. Where intense rainfall occurs, the overland flow may be so rapid that very little material is dissolved and carried into the stream systems.

Figure 2 shows the annual precipitation during 1960. Climatological data were obtained from publications of the U. S. Weather Bureau.

Rock Type

The characteristics of water in areas where the cultural influences are small are determined, for the most part, by the type of rocks in the area.

The quantity of mineral matter dissolved by water from rocks and soils depends primarily on the type of materials present, their solubility, the length of time of contact, and the chemical composition of the water.

Waters draining areas of crystalline rocks are usually low in mineral content and are soft. Silica may constitute as much as 50 percent or more of the dissolved minerals in the water. Calcium, magnesium, and sodium dissolved from these rocks are usually present in about equivalent amounts and their concentrations are low. Waters draining limestone or dolomite contain higher concentrations of mineral matter, principally the carbonates of calcium and magnesium.

Time of Contact

The time of contact with any material is one of the factors that determines how much of the material will go into solution. In areas of

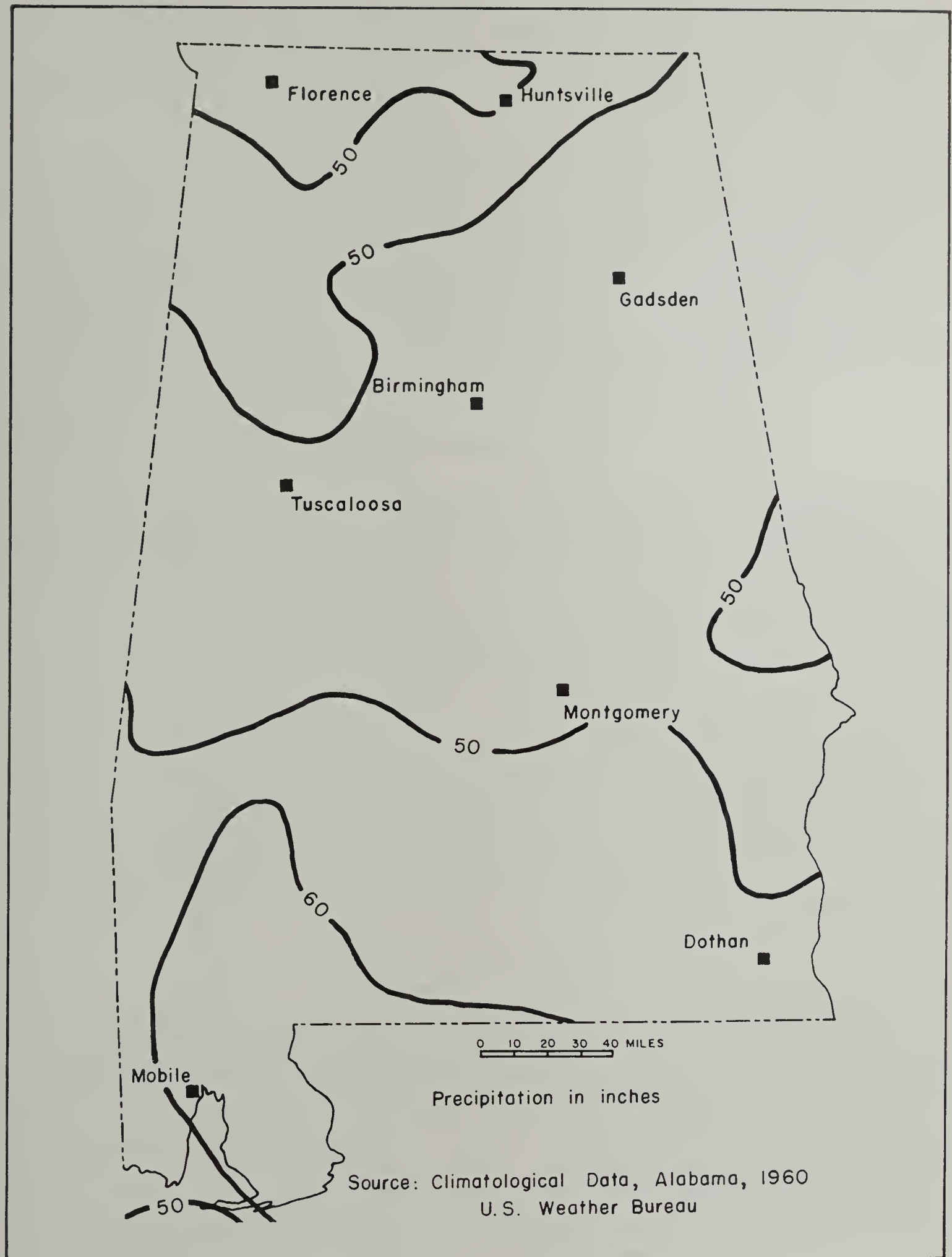


Figure 2. --Map showing total precipitation, 1960.

rugged topography, the rainfall runs off rapidly into the stream channels. This rapid runoff or storm flow is in contact with material for only a short time and is therefore less mineralized than other stream-flow. Storm flow thus dilutes the more mineralized water already in the stream.

Streamflow is maintained during low rainfall periods by groundwater seepage and spring flow, and some ground water enters the streams even during high rainfall periods either from springs or through seepage. Because water moves slowly underground, contact of water with materials is for a long period of time. Usually these ground waters are more mineralized than the surface waters and therefore increase the mineral content of the surface water.

Biologic Conditions

The total effect of biologic conditions on the quality of water has not been determined; in fact, the effect of many of the processes involved has been determined only to a small extent. The influence may be considerable although not readily apparent. In swampy areas, such as in and around Mobile, plant growth during the spring and summer is rapid. The dead and decaying plants form a thick blanket of vegetable matter in the water in the winter. Oxidation of this material depletes the oxygen content of the soil and water and increases the carbon dioxide content. Carbon dioxide dissolved in water forms carbonic acid, which increases the solvent action of the water on minerals with which it comes in contact. In the Mobile area, the soil and rocks exposed at the surface are, for the most part, only slightly soluble and the increase in mineral content of the water is slight. However, the decomposition of the vegetable matter releases organic compounds that impart color to the water.

Cultural Influences

In addition to the natural influences of rainfall, topography, biology, and geology, cultural influences also have an effect on the water quality. Materials introduced into the stream as municipal or industrial wastes and as a result of agricultural practices may have a considerable effect on the quality. Inorganic wastes introduced into the streams in small amounts may be below the limit of detection during periods of high flow, but during periods of low flow they might be of sufficient concentration to change the quality of the water appreciably. Organic wastes in streams may produce color, odors or tastes, reduce the dissolved oxygen content, or may, in themselves, be toxic to aquatic life.

In this study principal mineral constituents were considered, and only a few instances of contamination by municipal or industrial wastes were noted.

Storage may exert opposing influences on the quality of water. The chemical quality of the water in the reservoir may be improved by dilution with waters of low mineral content during periods of high runoff. On the other hand, concentrations of minerals may be increased by the process of evaporation and by solution of materials from the sides and bottom of the reservoir during storage.

CHARACTERISTICS OF WATER AND DISTRIBUTION OF MINERAL CONSTITUENTS

The characteristics and mineral constituents discussed in this section include those generally found to have some practical effect on the value of the water for a user.

A user, such as some industry, may have specific water quality requirements and these requirements generally vary from one industry to another.

These requirements, or limits of tolerances given in the following discussion, may be used as guides in evaluating the suitability of a water for a user. The brief description and limits of tolerances of the characteristics and mineral constituents were obtained from Rainwater and Thatcher (1960).

Mineral Content of Water

The mineral content is a calculated value obtained by summing the individual mineral constituents dissolved in water, expressed in parts per million. In this report the value usually includes: silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, fluoride, and nitrate. The mineral content is one of the best indicators of overall water quality. Water with a mineral content less than 500 ppm may be considered good for most purposes although a particular user may need to remove some constituents. The mineral content in most of the streams in Alabama is less than 500 ppm (table 10).

The areas of highest mineral content are in the northern, northeastern, and central parts of the State (fig. 3).

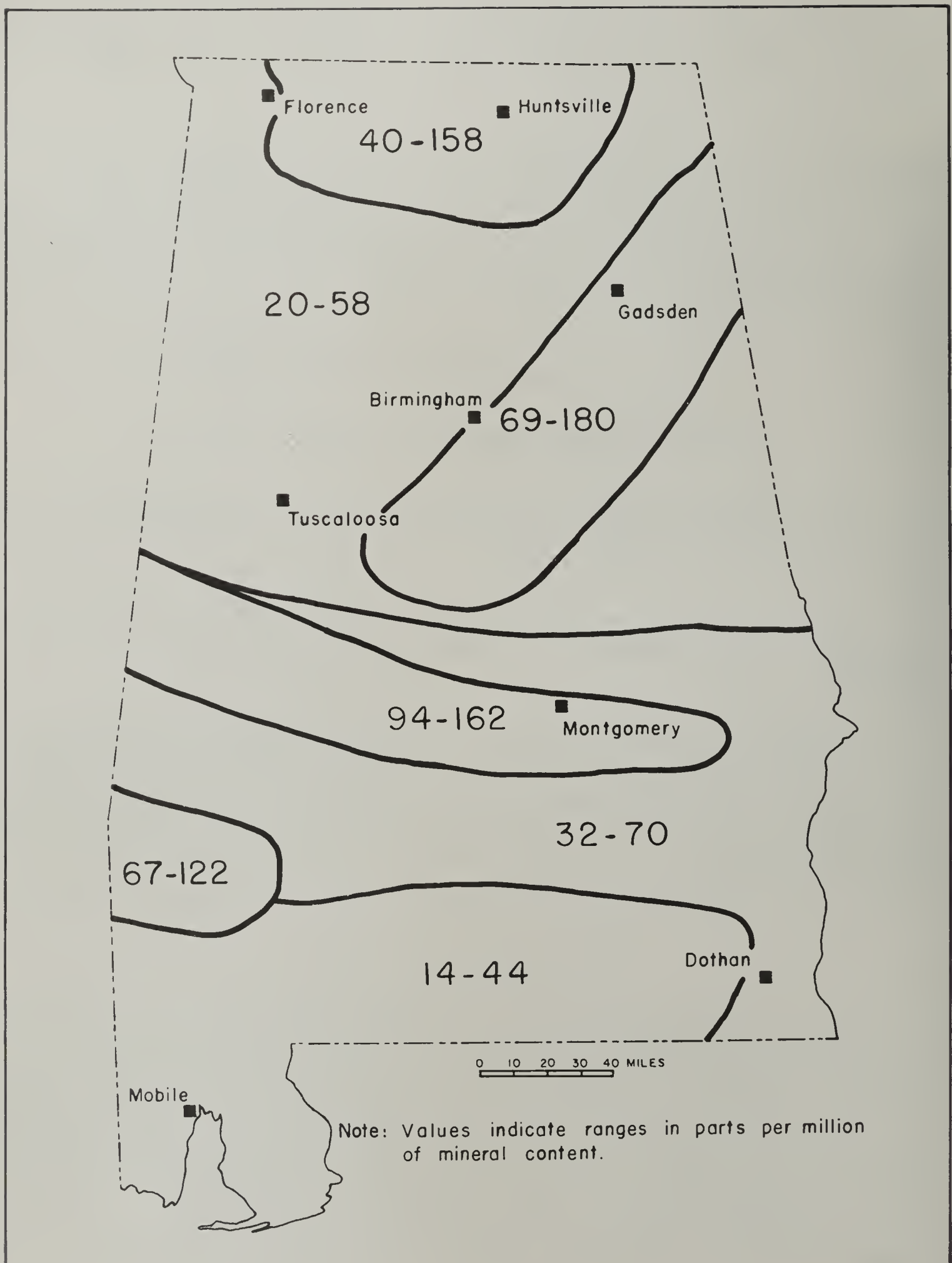


Figure 3. --Generalized map showing mineral content in Alabama streams, 1960.

The high mineral content in the northern part of the State is due mostly to contact of the water in the streams with limestone. Generally, streams draining the Tuscumbia Limestone have the greatest mineral content (table 10). This particular limestone seems to be more soluble than other limestone in the area. Streams draining the Red Mountain Formation also have a relatively high mineral content, although not as high as waters draining from the Tuscumbia Limestone.

The high mineral content in the northeastern part of the State appears to be associated with rocks of the Knox Dolomite and Chickamauga Limestone. Water draining from areas in which these formations are present not only exhibit a relatively high mineral content, but they also have a calcium to magnesium equivalents per million ratio (see appendix) of about 3 to 1. This ratio is considered to be typical of water draining from dolomitic type rocks.

The relatively high mineral content of stream water draining from a belt extending southeastward across the central part of the State seems to be associated with chalks in the Selma Group more than with any other rock type.

Some of the streams draining an area in and around Choctaw County exhibit relatively high mineral content. This relatively high mineral content may be due to contact of water in the streams with limestone that crops out at various points in the area.

Some of the streams along the southeastern boundary of the Selma Group and in the Chattahoochee River basin have relatively high mineral content. This relatively high mineral content is probably due to contact of water with the calcareous deposits in the underlying formations.

The waters of lowest mineral content occur in streams in the southwestern part of the State. This low mineral content is probably due to contact of the water with the relatively insoluble materials of the beach, flood plain, and terrace deposits of Pleistocene and Recent age.

Silica

Silica is one of the most abundant constituents in the earth's crust. Silicate minerals are particularly important in the composition of igneous and metamorphic rocks. Most silica in water is probably derived from decomposition or weathering of silicate minerals rather than from solution of quartz.

Silica is not physiologically significant to humans, livestock, or fish, nor is it of importance in irrigation water.

Most industrial processes tolerate silica in the range normally found, but it is particularly undesirable in boiler feed water. A recommended upper limit for boilers operating at 400 psi is 1 ppm. Silica forms a hard coating on steam turbine blades; therefore, a limiting concentration of 0.1 ppm in the steam has been recommended (Minhoff, 1948, p. 438).

Silica content in stream waters of the State forms no readily discernible pattern (table 10). There appears to be a tendency for the higher silica concentrations in streams draining crystalline rocks in the Piedmont province in the east-central part of the State. These silica concentrations are in the order of 9 to 10 ppm. Waters draining the limestone areas in the northern part of the State have the lowest silica concentrations, 5 to 7 ppm.

Iron

Iron is one of the most abundant elements in the earth's crust. Iron in concentration much greater than 0.20 ppm is objectionable in water for public supply. The U.S. Public Health Service recommends that the iron in drinking and culinary water on carriers subject to Federal quarantine regulations not exceed 0.3 ppm. These limits are not based on toxicity but on aesthetic and taste considerations. Iron tends to stain laundry and porcelain; also, it can be tasted in concentrations higher than about 1.0 ppm (Rainwater and Thatcher, 1960, p. 183).

The samples collected for the determination of iron were filtered in the field and acidified in the laboratory before the iron was determined. Iron concentrations are generally less than 0.10 ppm. A few streams contain concentrations greater than 0.20 ppm. These higher iron concentrations are not present in any particular area. Some streams had a high iron concentration during one of the surveys but had a low concentration during the other survey.

Sodium

Sodium salts are very soluble and most sodium leached from the soil or rocks tends to remain in solution. Industry uses large quantities of sodium salts; therefore, industrial wastes may contain large quantities of sodium. It has been established that more than 50 ppm of sodium

plus potassium in boiler water causes foaming. For high-pressure boiler feed water, a limiting concentration of 2 to 3 ppm has been recommended (Rainwater and Thatcher, 1960, p. 265).

There are several methods of classification of water as to suitability for irrigation. Water with a high ratio of sodium to calcium plus magnesium is deleterious to soil structure. The sodium-adsorption-ratio (SAR) is a useful index of the sodium hazard of irrigation water (U.S. Geol. Survey, 1958, p. 19-21). A few calculations employing the various classifications indicate that the water of the State would be good for irrigation purposes. Some streams that receive substantial quantities of industrial wastes may at times not be desirable. Too, the waters of streams in the tidal areas would not be desirable for most irrigational uses.

Generally, the sodium concentrations in streams of the State are less than 5 ppm. The sodium concentrations in the Cahaba River in the vicinity of Birmingham are among the highest observed in any stream except those in tidal areas. The concentrations in this stream are 2 to 29 ppm (table 10).

Sulfate

Sulfate is dissolved from most sedimentary rocks. Large quantities may be derived from beds of gypsum, sodium sulfate deposits, and some types of shale. Waters from mines may be high in sulfate as a result of oxidation of pyrite.

The U. S. Public Health Service (1962) recommends that sulfate concentration not exceed 250 ppm in drinking and culinary waters on carriers subject to Federal quarantine regulations.

Some sulfate (3 or 4 ppm) is present in most streams (fig. 4). The highest sulfate (above 20 ppm) occurs in some streams in two areas: in and around Birmingham, particularly in the Cahaba River basin above Centreville, and in the west-central part of the State. Many streams in these two areas contain less than 4 ppm sulfate.

Sulfate as high as 79 ppm was observed in the Cahaba River area. The source of sulfate was not determined; however, the sulfate may be from active and abandoned mines. There are several coal mines and iron mines in the area.

Streams in the west-central part of the State may contain 16 to 20 ppm of sulfate. Rocks in this area may contain gypsum which could be

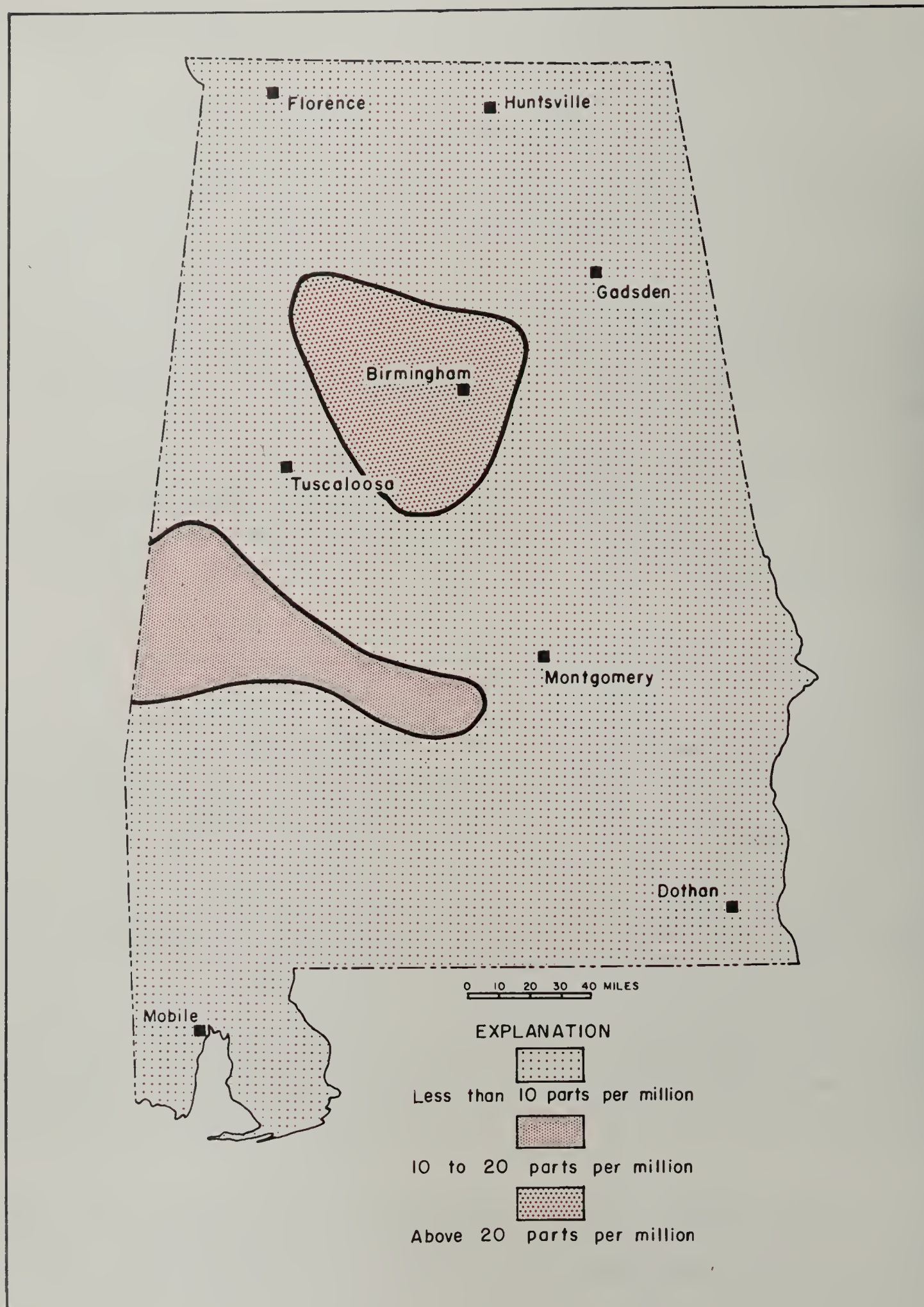


Figure 4. --Generalized map showing range in sulfate concentrations.

a source of sulfate in these streams.

Chloride

Water with a chloride content of 1,000 ppm may be physiologically safe; the U.S. Public Health Service (1962) recommends that the concentration not exceed 250 ppm in water on carriers subject to Federal quarantine regulations. Chlorides may accelerate corrosion in pipes, boilers, and other fixtures (Taylor, 1949).

Generally, the concentration of chloride in the waters of streams of Alabama is less than 10 ppm. The tidal streams were not investigated extensively but it is reasonable to assume that near the Gulf of Mexico in and around Mobile the chloride content might well be several thousand parts per million. The chloride concentration in the tidal reaches of a stream varies with tide stage and fresh-water discharge. Fish River near Yupton was the only stream sampled where the chloride was found to be extremely high (3,480 ppm on September 2, 1960). This sample was collected in the tidal reaches of the Fish River.

Fluoride

Excessive quantities of fluoride in drinking water may cause discoloration in the teeth of children during calcification; adults are not affected. Available evidence indicates that water containing less than 1.0 ppm of fluoride seldom causes mottling of children's teeth. On the other hand, abundant literature describes a reduction of tooth decay in children who drink water containing 0.88 to 1.5 ppm fluoride. Large quantities of fluoride are toxic but it has been reported that adults may safely drink 2 gallons per day containing 10 ppm of fluoride (Smith, 1944, p. 1293).

Fluorides are only sparingly soluble and are present in only very small amounts in stream waters of the State. Usually the fluoride concentrations are in the range of 0.1 to 0.3 ppm.

There does not appear to be any area of the State in which consistently higher or lower concentrations of fluoride are found.

Nitrate

Nitrates in large concentrations are injurious to the dyeing of wool and silk (California State Water Pollution Control Board, 1952, p. 301).

Excessive nitrate concentrations in water may cause blue babies. It is widely recommended that water containing more than 10 to 20 ppm of nitrate expressed as nitrogen should not be used in infant feeding (Comly, 1945).

Generally, the concentration of nitrates in Alabama streams was less than one part per million.

Color

Color of water as used in this report is due only to substances in solution. Color in water may be of natural, mineral, animal, or vegetable origin. Industrial wastes may also color water. Color is undesirable from aesthetic consideration and because it may dull clothes or stain food and fixtures. The U.S. Public Health Service (1962) states that color shall not exceed 15 units in drinking and culinary water on carriers subject to Federal quarantine regulations. Color is undesirable in water for many industries, particularly food processing, laundering, ice manufacturing, bottled beverage, photographic and textile industries (California State Water Pollution Control Board, 1952 and 1954, p. 226-228).

The waters in the streams north of the Fall Line (fig. 1) generally have very low color (95 percent had color less than 10). The waters in some streams south of the Fall Line have colors that exceed 10 units most of the time. The variation in the color of water is shown by figure 5.

Some of the streams south of the Fall Line contain appreciable color, but some have color less than 10 units. Generally streams in swampy areas are the most highly colored. Color seems to be most intense in the Mobile area where about 50 percent of the samples have color greater than 20 (fig. 5). The highest color observed was 80. In the area north of the Mobile area and south of the Fall Line, about 50 percent of the samples had color greater than 10. The highest observed color in this area was 90 units.

Specific Conductance

The specific conductance indicates the ability of water to conduct an electric current. The higher the specific conductance, the higher the mineral content. Because of the possibility of more extensive use of specific conductance in future water studies within the State and because the specific conductance was used to estimate the mineral content

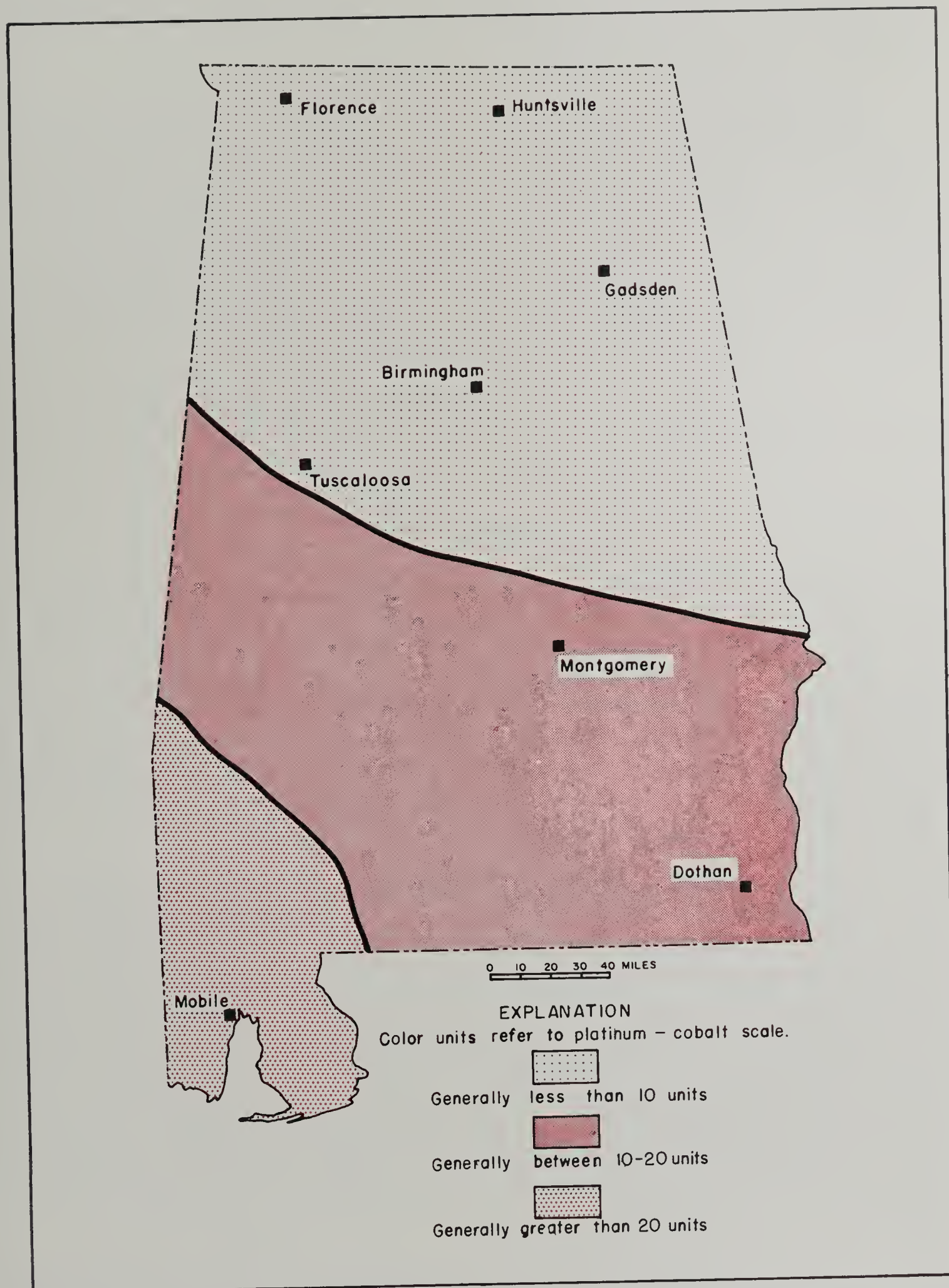


Figure 5. --Generalized map showing units of color of surface waters.

of waters in many streams during this reconnaissance, it seems desirable to include a brief discussion of the relationship of the specific conductance to the mineral content.

The mineral content of waters may be different and yet the waters may have the same specific conductance. The relationship of specific conductance to mineral content depends on the nature of the mineral constituents. A concentration in parts per million of sodium would have a different specific conductance from an equal concentration of calcium. Waters draining an area of limestone, for example, probably would contain higher concentration of calcium than of sodium. Waters draining a coastal area may contain more sodium than calcium and yet the specific conductance for these waters could be the same.

Figure 6 shows, by areas, the relation of mineral content to specific conductance.

Hardness

Hardness is the property of water attributable to the presence of alkaline earths such as calcium and magnesium. Hardness represents the soap-consuming power of water (Hem, 1959, p. 145), as soap will not cleanse or lather until the constituents contributing to hardness have been either precipitated or neutralized. Hard water is not generally believed to have harmful effects on man although the relation to urinary concretion is controversial. Water with less than 31 ppm hardness is considered to be very soft, from 31 to 60 ppm is soft, from 61 to 120 ppm is moderately hard, 121 ppm and above is hard.

Stream waters in Alabama range from very soft to hard (fig. 7). The hardest water is found in three different areas: in the northern one-eighth of the State, in the Tennessee section, and in a belt extending across the south-central part of the State. In the northern part of the State, hardness ranged from about 51 to 142 ppm during the August-September stream survey. The highest hardness observed in this area was 165 ppm. Much of the water during low flow is probably from springs or seepage from the banks. Most of the hardness is due to calcium dissolved from limestone. The ratio of the calcium to magnesium equivalents per million is about 12 to 1. This ratio indicates that most of the hardness is due to contact with limestone rather than with dolomite.

Hardness of water in the Tennessee section is due to contact with limestone and dolomite. The ratio of calcium to magnesium in these waters is about 3 to 1. Some of the streams in this area tend to be soft,

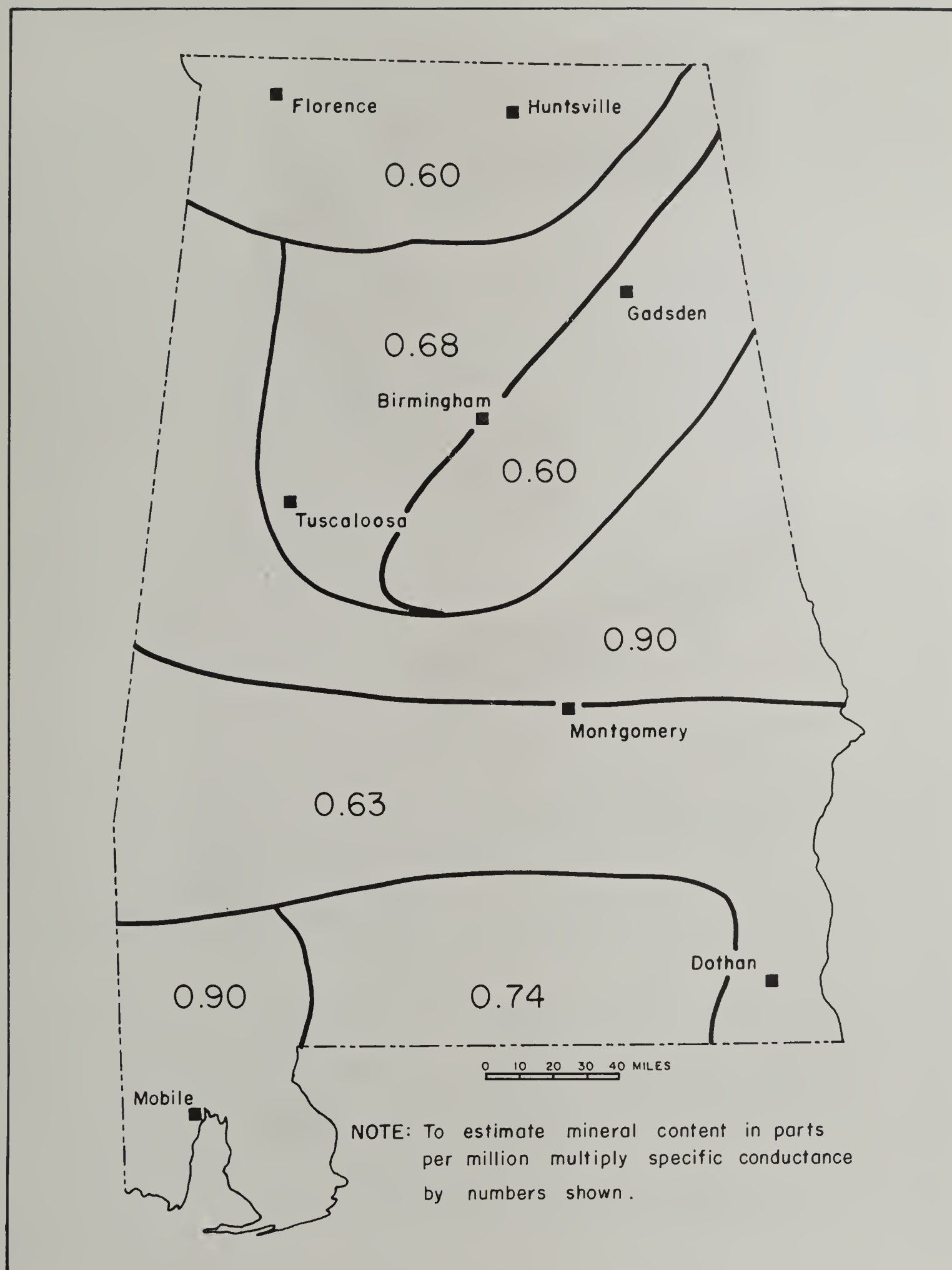


Figure 6. --Generalized map showing relation of mineral content to specific conductance, by areas.

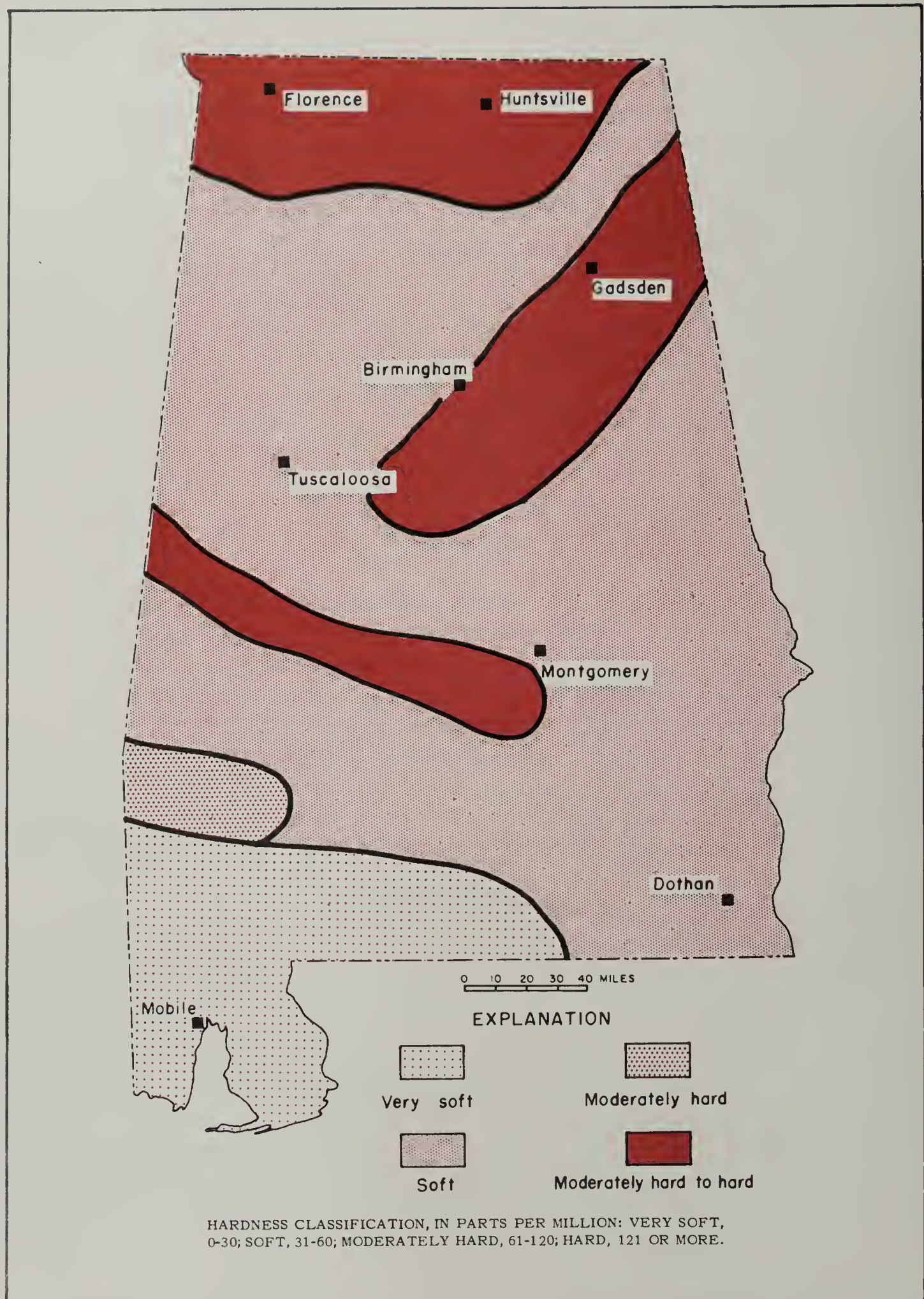


Figure 7. --Generalized map showing distribution of hardness of water.

as their waters contact less soluble rocks such as chert, shales, and sandstone.

Hard waters in the belt extending across the south-central part of the State are due to contact with the calcareous deposits in the Selma Group. The calcium to magnesium ratio is relatively high, which indicates that the water was primarily in contact with a limestone and had very little or no contact with dolomite.

Other areas in which the water tends to be hard include a small area in Choctaw County and an area in Houston County. Parts of these areas are underlain by limestone. Moderately hard water may be found in some of the streams in the southern part of the State in the Chattahoochee River basin near Eufaula. These moderately hard waters are probably caused by calcareous deposits in the rock formations underlying the area.

Soft waters (less than 61 ppm) occur in streams of the Piedmont Upland section, west-central to central Alabama, and in the southeastern part of the State. Very soft water is found in the southwestern part of the State (fig. 7). The hardness of these waters is generally less than 15 ppm.

Water Type

Water is typed mainly on the basis of concentration of the negative ions in parts per million. The higher concentrations determine the type. The use of parts per million provides a scheme by which silica can be included equally with other constituents. Carbonate as used in this report includes bicarbonate calculated as carbonate. This typing is a modification of the method used by Clarke (1924, p. 182-195).

Carbonate waters occur in streams in most of the State (fig. 8). In the north part of the State, the carbonate water in the Tennessee section is due to contact of water with dolomitic rocks. The carbonate water in the Highland Rim section is due to contact with limestone. In these two parts the carbonate concentration (HCO_3 and CO_3), in parts per million, is among the highest in the State. The intermediary part (Cumberland Plateau section) is underlain by sandstone and shale and the carbonate occurs in lower concentration than in the other two parts of the area.

Carbonate waters occur also in the southern part of the State except in and around Mobile County where the waters are generally siliceous in type. The area in and around Selma has higher concen-

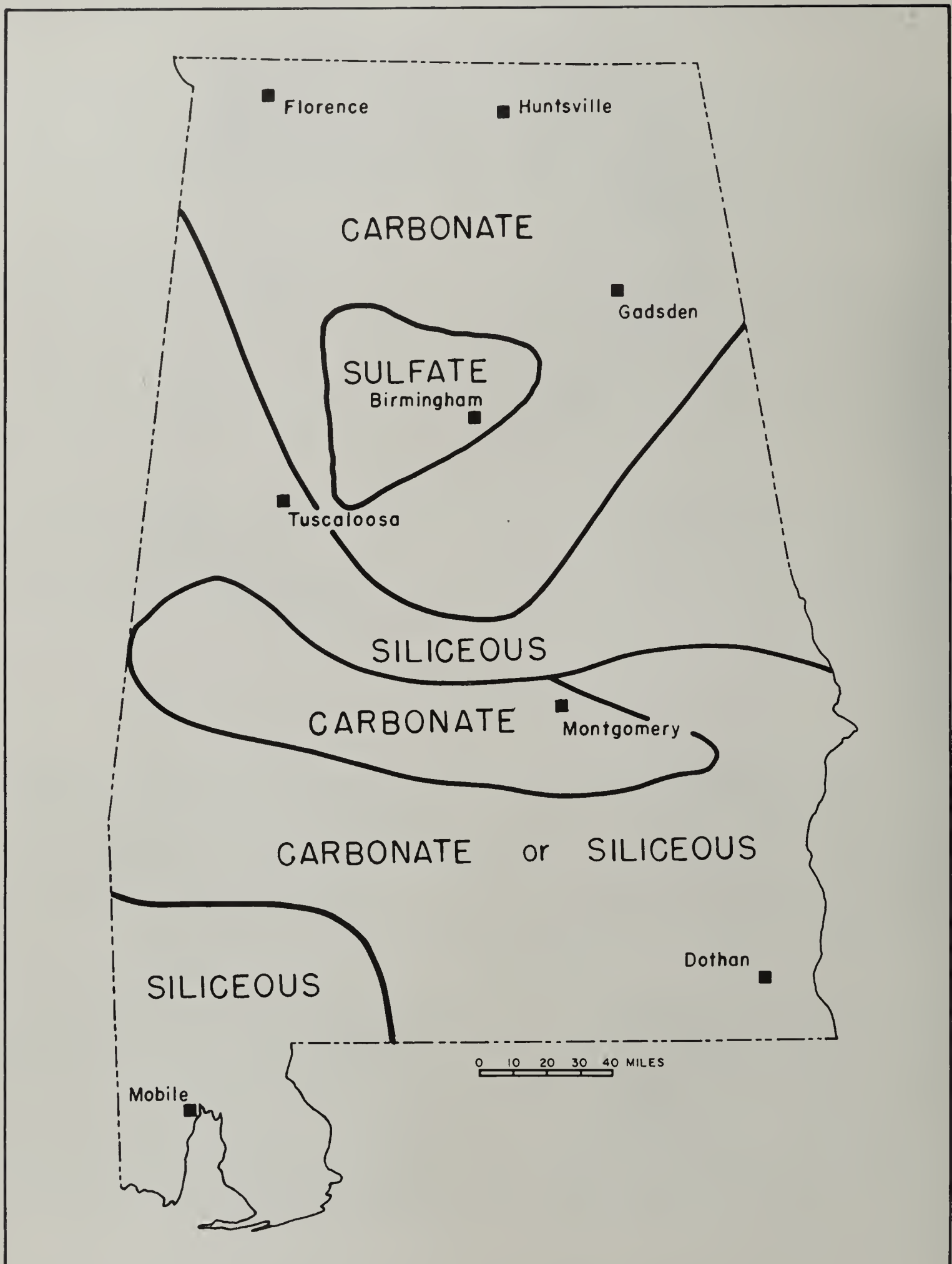


Figure 8. --Generalized map showing types of water.

trations of carbonate (HCO_3 and CO_3) than does the remainder of the southern part of the State. The carbonate water in this area is probably due to contact of the water with calcareous deposits in the Selma Group.

The carbonate water in the remainder of the southern part of the State is due to contact of water with calcareous deposits. These calcareous deposits occur at various places in this area. In periods of higher flow the waters probably would be siliceous in type and during lower flow they would be carbonate in type. In some parts of this area where no limestone is present, the waters probably would be siliceous during high and low flows.

Siliceous type waters occur in a horseshoe-shaped belt extending across the central part of the State. The northwest and central parts of the State are underlain chiefly by sand and gravel. Rocks in the east-central part of the State are crystalline. Silica in the water is probably derived from the weathering of these rocks, sands, and gravels.

Sulfate water (up to 70 ppm) occurs in some streams in and around Birmingham. No specific attempt was made to link the sulfate to the source; however, sulfate may be derived from pyrite usually associated with shales.

Some stream water in and around Marengo County is of the sulfate type. The sulfate may be caused by impurities in the calcareous deposits in this area.

WATER QUALITY BY AREAS

The data obtained during this study indicated that waters of a particular characteristic were confined to general areas of the State. The preceding maps indicated several of the water characteristics.

Natural influences generally control water quality of streams in Alabama. The Piedmont province of Alabama is underlain by a relatively insoluble rock; therefore, the water draining this area should be low in mineral content. There is a tendency for the overall mineral content to be similar from one stream to another, and the ratio of one mineral constituent to another tends to be the same.

If a stream has a higher mineral content than other streams in the area, then significant cultural influences would be indicated. Anomalous characteristics of water quality would occur, of course, particularly within the larger areas. Nevertheless, the greater quantity of water or number of streams would be expected to have similar characteristics

and the concentration of the individual mineral constituents would be expected to fall within limits established for the areas.

The delineation of areas (fig. 9) therefore permits large quantities of water and vast areas to be defined with a few index data-collection points. It aids in the prediction of water quality that may occur in a stream crossing more than one area. For example, if a stream that originates in an area of relatively insoluble rocks, and therefore is low in mineral content, flows into an area of soluble rocks, then an increase in mineral content could be expected. A rough estimate of the increased content could be made, based on the quantity of water from the respective areas. Abrupt changes in water quality in streams flowing through areas not coincident with changes due to areal variations would suggest significant cultural influences.

A potential water user, such as an industry, may be desirous of water of a certain quality. The delineation and definition of water quality by areas would permit the selection or exclusion of certain areas immediately.

For the most part, delineation of the water quality areas has coincided with geologic or topographic features. These areas have been delineated based on data collected primarily during the August-September 1960 survey. These data are confined to tributary streams draining mostly the area in discussion. The larger streams (streams draining more than one area) are discussed in another section of this report. Those data from streams which were known to be significantly influenced by cultural influences were withdrawn from the tabulation used to determine the area characteristics; these streams are discussed separately.

The ranges in chemical characteristics are based on 80 percent of the observations made during the August-September survey. This 80 percent is the middle range of values, omitting the upper and lower 10 percent. This was done to eliminate those observations which were considered to be extremes.

The following discussion summarizes the relationship of the chemical characteristics of the water within these areas and relates these characteristics to environmental factors.

Area I

Area I is in the northern part of the State and is coextensive with the Highland Rim section. The Tennessee River system is the major river system of this area.

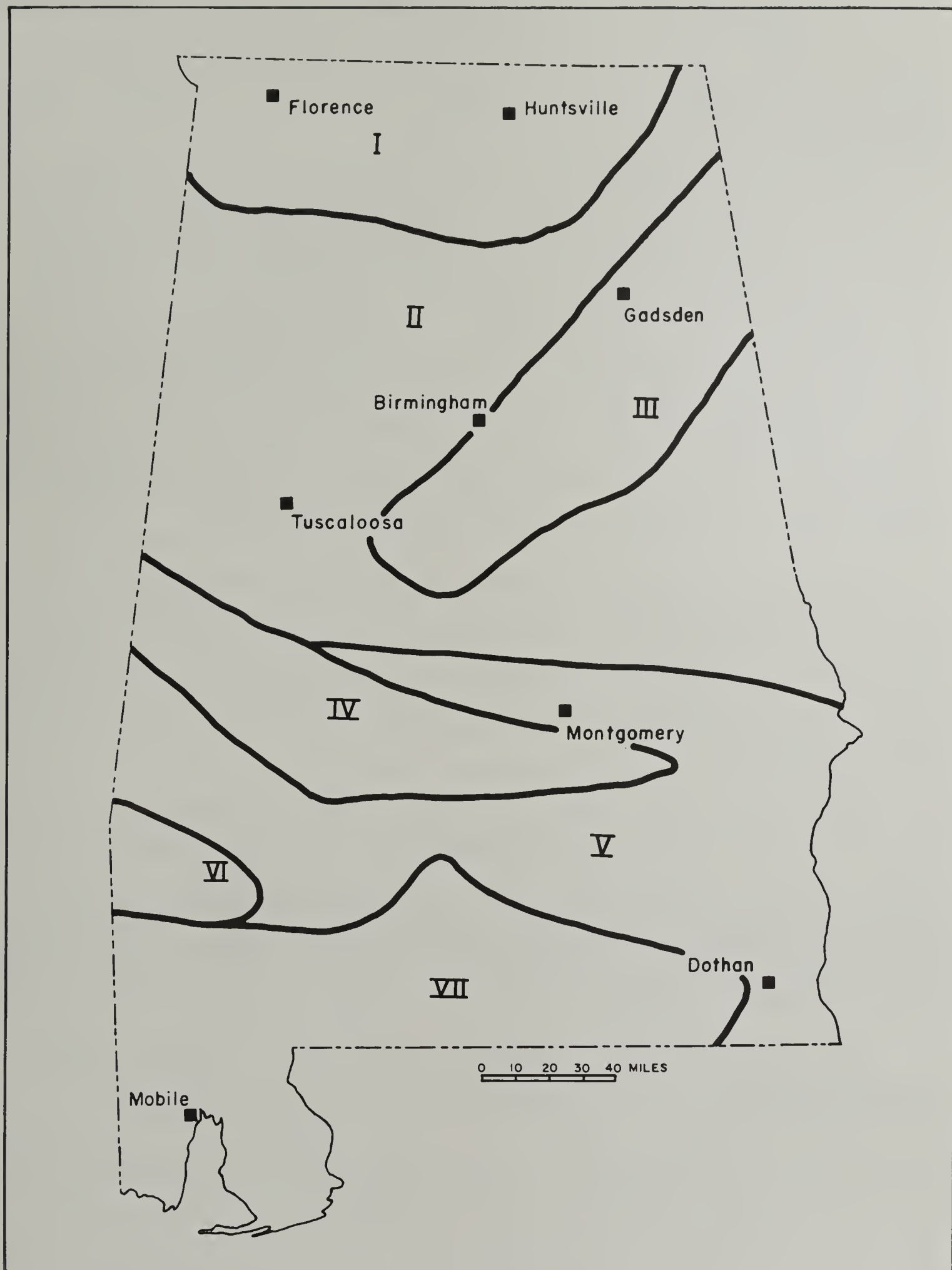


Figure 9. --Generalized map showing areas of similar quality of water.

Limestone, chert, sandstone, and shale crop out in the Huntsville area (Sanford, 1957, p. 4). Limestone, sandstone, and some sand, gravel, and clay are in the western part of the area (Harris, 1957). The limestone is relatively soluble in water. The chert, sandstone, shale, gravel, and sand are relatively insoluble.

This area differs from the bordering area in that the mineral content of the streams in this area is higher than in those in the bordering area. Streams draining the Tusculumbia Limestone are more mineralized than streams draining other formations in the area. Streams in the northwest corner of the area are the least mineralized. Variations in chemical character of the water appear to be related mostly to differences in rock composition. Cypress Creek and its tributaries are less mineralized than the Flint Creeks and Anderson Creek. Cypress Creek drains the insoluble sand and gravels of the Tuscaloosa Group. The Flint Creeks drain more soluble limestone. Cypress Creek and the surrounding area are included within Area I because of insufficient information for delineation of any other area or subarea.

Specific conductance of about 80 percent of the streams in this area is within the range 67-276 micromhos. Color ranged from 2 to 4 units. This indicates that very little organic material is present and that most of the mineral constituents present were determined. Streams were turbid during periods of high flow. An analysis from Indian Creek near Huntsville is considered to be typical of Area I. This analysis is shown in table 1.

The water ranges from soft to hard in this area. The hard waters are in those streams draining limestone, and the soft waters are in those streams draining sand, gravel, sandstone, and chert. Hardness ranges from 34 to 146 ppm in 80 percent of the samples. The concentration of sulfate plus chloride was generally less than 10 ppm and the concentration of silica usually was about 6 to 7 ppm. The pH of these waters ranged from about 7.0 to 8.0.

The mineral content in parts per million can be readily estimated by multiplying the specific conductance by 0.60 (fig. 6).

There are many springs in this area. These springs serve as an important source of water for municipal supplies. In Colbert and Lauderdale Counties, the flow in most of the streams from September to November is maintained by spring flow (Harris, 1957). Water that has been underground generally is more mineralized than water that has not.

Table 1. -- Analysis of water typical of Area I
(Indian Creek near Huntsville, August 31, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (Micromhos)	134		
pH	7.2		
Color	2		
Sum		81	
Dissolved solids		79	
Silica		7.3	
Iron		.10	
Calcium		23	1.15
Magnesium		3.0	.25
Sodium		1.0	.04
Potassium		.1	.00
Bicarbonate as carbonate	HCO ₃	(83) 41	1.36
Sulfate		.8	.02
Chloride		3.2	.09
Fluoride		.1	.01
Nitrate		1.5	.02

Area II

Area II includes the Cumberland Plateau section of the Appalachian Plateaus province, the Piedmont Upland section of the Piedmont province, and a part of the East Gulf Coastal Plain section of the Coastal Plain province. The mineral content of this area is lower than the mineral content in the bordering areas (Areas I, III, IV, V).

The northeastern part of this area (Cumberland Plateau section) is underlain by sandstone and shale; the western and southern parts (East Gulf Coastal Plain section) are underlain by beds of sand and gravel; and the southeastern part (Piedmont Upland section) is underlain by metamorphic rocks, mainly schist.

These rocks are relatively insoluble in water; therefore, the waters draining from the area are low in mineral content. The mineral content ranged from 20 to 58 ppm and the specific conductance ranged from 23 to 65 micromhos in 80 percent of the samples. The mineral

content of the water in parts per million may be estimated by applying a factor to specific conductance, 0.68 for the northeast and 0.90 for the remainder of the area.

Topsoil has been removed and the red clay subsoil has been exposed in the southeastern part of the area (Peirce and Brown, 1955, p. 48). Erosion causes the streams in this part of the area to be highly turbid during high flow.

Table 2 shows the extremes in water temperatures at three locations within this area.

The waters of this area are soft; hardness ranged from 8 to 24 ppm in 80 percent of the samples. The pH ranged from 6.5 to 7.3. The sum of the sulfate and chloride generally was less than 10 ppm. Most of the waters contain almost no color (less than 10 units) although a few streams have colors greater than 10 units. The highest color observed in this area was 36 units.

An analysis from Town Creek near Geraldine was considered to be typical of Area II. This analysis is shown in table 3.

Area III

Area III is a belt extending from the central part of the State to the northeast-central part of the State. The boundaries of this area are almost the same as the boundaries of the Tennessee section.

There are about 5,500 square miles in this area; about 4,400 square miles are in the Coosa River basin and 1,100 square miles are in the Cahaba River basin. Several cities, such as Gadsden, Birmingham, and Talladega, obtain water from surface-water sources. Talladega, for instance, uses water from Talladega Creek. The farm land in the Coosa River terraces around Gadsden and Centre is particularly well suited to truck farming and is well located for irrigation from adjacent streams (Peirce and Brown, 1955, p. 50). The water of this area is good for irrigation purposes.

This area is underlain by limestone, dolomite, and shale. The limestone and dolomite are relatively soluble in water; therefore, the streams draining the area are among the most highly mineralized in the State. The Little Cahaba River near Leeds had the highest observed mineral content (192 ppm) on August 31, 1960. The water ranges from moderately hard to hard and is slightly alkaline.

Table 2. --Extremes in water temperature for three stations in Area II

Station	Period of record (temperature)	Water temperature			
		Maximum		Minimum	
		°F	Date	°F	Date
North River near Tuscaloosa	Oct. 1958- Sept. 1959	87	Aug. 5, 7, 18, 20, 22, 1959	36	Dec. 16-19, 22, 1958
Big Sandy Creek at Duncanville	July 1958- Sept. 1959	75	July 29, 1959	39	Jan. 6-7, 1959
Hurricane Creek near Holt	Aug. 1958- Sept. 1959	90	June 30, 1959	32	Dec. 17, 19, 1958, and Jan. 6-7, 1959

Table 3. -- Analysis of water typical of Area II

(Town Creek near Geraldine, August 31, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	40		
pH	6.4		
Color	3		
Sum		27	
Dissolved solids		28	
Silica		2.1	
Iron		.04	
Calcium		3.6	0.18
Magnesium		.6	.05
Sodium		2.8	.12
Potassium		2.0	.05
Bicarbonate	HCO ₃	(15)	.25
as carbonate		7.4	
Sulfate		4.8	.10
Chloride		3.8	.11
Fluoride		.1	.01
Nitrate		.2	.00

Several streams in the area receive water from relatively insoluble rocks, such as shale, but are included in Area III because of insufficient information for delineation of any other area or subarea. Kelly Creek and Bear Creek near Vincent are examples. These streams are low in mineral content and the waters are soft.

There is good correlation between the specific conductance and the mineral content of the water (fig. 10). The mineral content, in parts per million, may be estimated by applying a factor of 0.60 to the specific conductance (fig. 6). The specific conductance ranged from 63 to 340 micromhos with 80 percent of the specific conductance values falling in the 137 to 296 range. The mineral content in 80 percent of the samples ranged from 82 to 180 ppm. The water has almost no color. The highest color observed was 11 units.

The calcium to magnesium ratio is about 3 to 1, which indicates that most of the water in the area has contacted dolomite. High concentrations of sulfate (highest observed, 79 ppm) occur in the Cahaba River

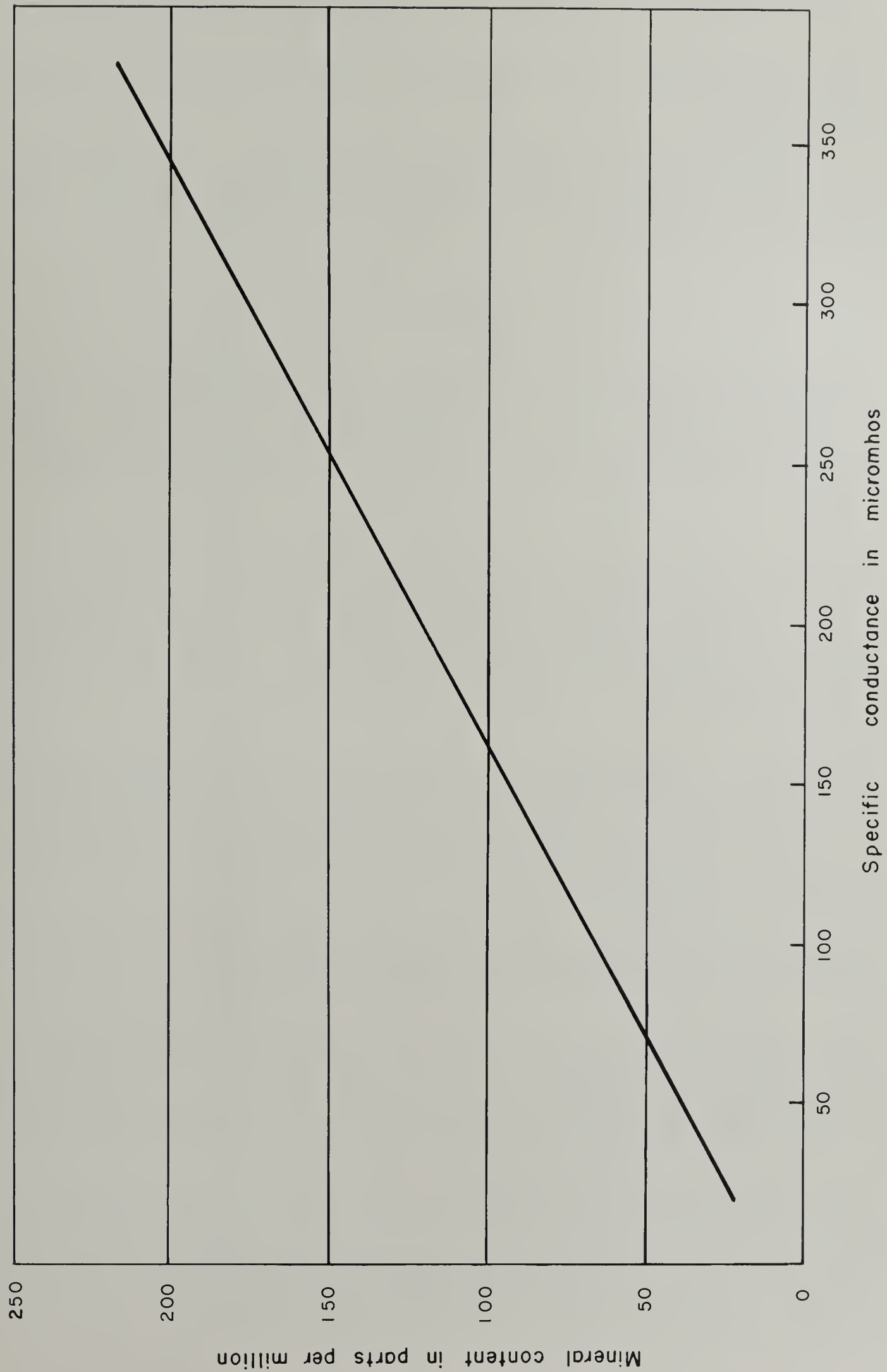


Figure 10. --Relation of the specific conductance to the mineral content in Area III.

basin in the western part of the area. These concentrations of sulfate are probably derived from pyrite in the shale underlying the area.

Table 4 shows the extremes in water temperature at two locations within this area.

An analysis from Big Canoe Creek near Gadsden, August 31, 1960, is considered to be typical of an analysis of water from Area III. This analysis is given in table 5.

Area IV

Area IV is a belt extending from the west-central part of the State to the southeast-central part of the State, ending in Bullock County. This area has the same general boundaries as the Black Prairie Belt, "a crescent shaped undulating plain of 4,000 square miles" (Peirce, 1954, p. 3).

The formations underlying this area have a low permeability and most of the rain that falls on them is quickly evaporated or runs off. As a result, the streams of this region are flashy during rainy periods but have little or no flow during extended dry periods. Some of the larger streams draining this area cease flowing during periods of little rainfall (Peirce, 1959, p. 143).

This area is underlain by chalk and marl. Streams draining this area are among the most highly mineralized in the State but are generally a little less mineralized than those of Area III. The highest observed mineral content was 194 ppm at Chickasaw Bogue near Linden, Ala., August 31, 1960.

Specific conductance ranged from 108 to 346 micromhos with 80 percent of the samples falling in the 168 to 294 range.

The water of this area differs from the water in Areas I and III in that there appears to be almost no magnesium present. This indicates that the water did not contact any dolomite as did the water in Areas I and III. The ratio of calcium to magnesium (epm) is more than 10 to 1.

The waters range from soft to hard. The pH of 80 percent of the samples analyzed was in the 7.0 to 7.9 range. Streams of this area contain moderate concentrations of sulfate (about 10 ppm). The sulfate may be related to gypsum deposits within the chalk or marl. Streams in this area have some color, usually less than 20 units.

Table 4. --Extremes of water temperature at selected stations in Area III

Station	Period of record (temperature)	Water temperature			
		Maximum	Minimum		
		°F	Date	°F	Date
Ohatchee Creek at Reads	Sept. 1958- Sept. 1959	76	Aug. 30, 1959	45	Jan. 17, 23, 24, 1959
Tallahatchee Creek near Wellington	Aug. 1958- Sept. 1959	77	June 30, July 29, 1959	40	Jan. 6, 1959

Table 5. -- Analysis of water typical of Area III
(Big Canoe Creek near Gadsden, August 31, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	207		
pH	7.3		
Color	4		
Sum		124	
Dissolved solids		128	
Silica		7.8	
Iron		.02	
Calcium		34	1.70
Magnesium		6.7	.55
Sodium		1.8	.08
Potassium		.7	.02
Bicarbonate	HCO ₃	(135)	2.21
as carbonate		67	
Sulfate		4.0	.08
Chloride		1.8	.05
Fluoride		.1	.01
Nitrate		.4	.01

An analysis of water from Big Swamp Creek near Lowndesboro is considered to be typical of an analysis of water from Area IV. This analysis is given in table 6.

Area V

Area V is wholly within the East Gulf Coastal Plain section. It includes several divisions of the East Gulf Coastal Plain delineated as forest regions by Harper (1913, frontispiece). These divisions include the Chunnennuggee Hills and most of the Southern Red Hills and a portion of the Central Pine Belt (fig. 1).

Streams draining the outcrop area of the Selma Group tend to be more mineralized than those more distant. The observed mineral content in 80 percent of the samples ranged from 32 to 70 ppm. The more

Table 6. -- Analysis of water typical of Area IV

(Big Swamp Creek near Lowndesboro, August 31, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	294		
pH	7.9		
Color	21		
Sum		172	
Dissolved solids		189	
Silica		10	
Iron		.03	
Calcium		59	2.94
Magnesium		.5	.04
Sodium		4.4	.19
Potassium		2.8	.07
Bicarbonate	HCO ₃	(168)	2.75
as carbonate		83	
Sulfate		4.8	.10
Chloride		7.0	.20
Fluoride		.3	.02
Nitrate		.0	.00

mineralized streams probably drain areas underlain by calcareous deposits. The waters are soft. Hardness ranged from 13 to 41 ppm and the pH from 6.7 to 7.5 units in 80 percent of the samples. The highest observed hardness in the area was 94 ppm, the lowest 10 ppm. Most of the streams in the area had very little color. The highest color observed was 30 units, the lowest 2. The usual range of color was from 3 to 18 units (80 percent of the samples). Usually the sum of the sulfate plus chloride is less than 10 ppm in the water of streams in this area.

The chemical characteristics of the water of this area are more variable than those of some other areas. Most of the streams in this area are carbonate in type but may occasionally be siliceous. Others may be siliceous most of the time.

The analysis given in table 7 is considered to be typical of this area. The sample for this analysis was collected from Cowike Creek near Eufaula, Ala., August 30, 1960. This area differs from the surrounding areas in that the mineral content generally is lower than in

Table 7. -- Analysis of water typical of Area V
(Cowike Creek near Eufaula, August 30, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	98		
pH	7.1		
Color	10		
Sum		58	
Dissolved solids		59	
Silica		6.6	
Iron		.11	
Calcium		15	0.75
Magnesium		1.1	.09
Sodium		2.5	.11
Potassium		1.2	.03
Bicarbonate	HCO ₃	(44)	.72
as carbonate		22	
Sulfate		6.4	.13
Chloride		3.0	.08
Fluoride		.2	.01
Nitrate		.0	.00

Area IV or VI and generally is higher than in Area II or VII. Lack of sufficient information prevented any further delineation of subareas.

Area VI

Area VI is in southwestern Alabama, in and around Choctaw County. The boundaries are in general the same as those designated "Lime Hills" (fig. 1).

The chemical characteristics of the water of this area are probably related to the calcareous deposits underlying the area.

Very little data (11 samples, 7 during the August survey) were collected from this area during this study.

The mineral content is higher in the water in this area than in the water in the surrounding areas.

Oil was discovered in the Gilberttown area in 1944 (Toulmin and others, 1951, p. 4). Relatively high chloride concentrations are present in the water of some streams (Alabama Water Improvement Advisory Commission, 1949, p. 78). It may be that some of the higher mineral contents observed during this study are due to oil producing activities. The mineral content was 684 ppm (computed) in one of the samples during the August survey. In May 1960, the chloride was 40 ppm in the Okatuppa Creek at Gilberttown. The principal mineral constituents in the water of the streams during this study would be bicarbonate and those contributing to hardness (calcium and magnesium). Outside the areas of probable pollution the highest observed specific conductance was 270 micromhos. The mineral content in this sample would be about 160 ppm.

The water ranges from soft to hard, the pH from 7.2 to 8.6 units. The highest observed color was 80 units in the Souwilpa Creek at Souwilpa, Ala.

The analysis of water collected from Satilpa Creek near Coffeeville on May 1, 1960, was considered to be a typical analysis of water from this area. This analysis is given in table 8.

Table 8. -- Analysis of water typical of Area VI

(Satilpa Creek near Coffeeville, May 1, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	122		
pH	7.8		
Color	7		
Sum		80	
Dissolved solids		94	
Silica		15	
Iron		.01	
Calcium		22	1.10
Magnesium		.4	.03
Sodium		1.9	.08
Potassium		.8	.02
Bicarbonate	HCO ₃	(67)	1.10
as carbonate		33	
Sulfate		4.0	.08
Chloride		2.1	.06
Fluoride		.1	.01
Nitrate		.3	.00

Area VII

Area VII is in the southwestern part of the State. It is entirely within the East Gulf Coastal Plain section and includes the physiographic division referred to as the Southwestern Pine Hills and a part of the Southern Red Hills and the Lime Hills (fig. 1).

The western part of the area is underlain by beach, flood plain, and terrace deposits; the eastern part is underlain by sand and clay (Adams and others, 1926). These deposits are essentially insoluble in water; therefore, streams draining this area are low in mineral content and soft.

The water from this area tends to contain a lower mineral content, lower pH, and higher color than water in the bordering areas.

The observed mineral content ranged from 14 to 44 ppm and specific conductance ranged from 17 to 63 micromhos in 80 percent of the samples. The mineral content, in parts per million, in the eastern part of the area may be estimated by applying a factor of 0.74 to the specific conductance and in the western part by applying a factor of 0.90 to the specific conductance.

Streams in this area have the lowest pH and highest color of any streams in the State. Nearly all streams in the area have a pH less than 7.0. Streams in the western part of the area in and around Mobile County have the lowest pH. The lowest observed was 4.5 units. Almost 50 percent of the streams in this area have color greater than 20 units. The highest observed color was 90 units.

The water is soft. Hardness ranges from 4 to 28 ppm in 80 percent of the samples. The softest water is in and around Mobile County where about 80 percent of the streams have a hardness less than 10 ppm.

An analysis of the water from Fish River near Silver Hill is considered to be typical of an analysis of water from this area. This analysis is given in table 9.

WATER QUALITY BY RIVER BASINS

Alabama is drained by three large rivers and several small rivers. The large rivers are the Chattahoochee River, the Mobile River, and the Tennessee River. Small rivers include the Choctawhatchee, Yellow, Conecuh, Perdido, and Escatawpa Rivers.

Table 9. -- Analysis of water typical of Area VII

(Fish River near Silver Hill, September 2, 1960)

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	22		
pH	6.0		
Color	7		
Sum		19	
Dissolved solids		16	
Silica		7.3	
Iron		.03	
Calcium		1.2	0.06
Magnesium		.4	.03
Sodium		2.4	.10
Potassium		.3	.01
Bicarbonate	HCO ₃	(6)	.10
as carbonate		3	
Sulfate		.4	.01
Chloride		4.0	.11
Fluoride		.1	.01
Nitrate		.2	.00

The rivers of Alabama from headwater to mouth are exposed to many natural and cultural influences that result in constantly changing features of water quality. In this section quality of water in the rivers is discussed. Chemical characteristics of the headwater stream are discussed first, succeeding changes to the mouth of the stream second, and tributaries in downstream order last, unless otherwise indicated.

Mineral content is presented throughout this section by use of a number followed by one or two numbers in parentheses, that is, 3 (20-30); 3 indicates the number of comprehensive analyses for this data-collection point or points, and 20-30 designates the range in parts per million of mineral content in the water collected from streams at these points.

Diagrams showing mineral content at points on the stream are included under discussion of the individual rivers.

Rivers are discussed in the following sequence: the Chattahoochee River, the Choctawhatchee River, the Yellow River, the Conecuh River, the Coosa River, the Tallapoosa River, the Alabama River, the Black Warrior River, the Tombigbee River, the Mobile River, and the Tennessee River.

Chattahoochee River

The Chattahoochee River rises in the Blue Ridge Mountains near Cleveland, Ga., flows southwestward through the Piedmont province to near Lanett, Ala., then southward forming the Georgia-Alabama State boundary, and joins the Flint River in the reservoir of Jim Woodruff Dam to form the Apalachicola River.

Drainage in Alabama into the Chattahoochee River is limited to small eastward flowing rivers. Most of these streams have steep slopes with broad flood plains in the upper reaches but have eroded deep channels near confluence with the Chattahoochee River (Peirce, 1954, p. 5).

At Columbia, Ala., the Chattahoochee River drains an area of approximately 8,040 square miles and the average discharge for 31 years of record is 10,490 cfs (unadjusted). Flow is regulated by Lake Sidney Lanier and Bartletts Ferry Reservoirs (U.S. Geol. Survey, 1960b, p. 229).

Several cities--Abbeville, Bartletts Ferry, Columbia, Eufaula, Fairfax, Lanett, and Phenix City--receive water supplies from the Chattahoochee River or its tributaries.

Abbeville, Columbia, Dothan, Fairfax, and Phenix City are some cities that dispose of all or part of their wastes into the Chattahoochee River or its tributaries (Alabama Water Improvement Advisory Commission, 1949, p. 239).

Plate 1 shows the locations from which data concerning water of the Chattahoochee River basin were obtained. At 33 different data-collection locations in the basin, 42 samples were obtained during this study. Daily stations (samples of water collected daily for analysis) were operated at Phenix City (Columbus, Ga.) and at Columbia, Ala., during 1940 and 1941. Analysis of samples shows the water of the Chattahoochee River to be low in mineral content and soft. About 25 percent of the mineral content is silica. Comparison of analyses of samples collected during this study (table 10) with previous analyses (Carter and

others, 1949, p. 244-246; Peirce, 1955, p. 251-263) does not indicate an overall change in chemical quality of the water.

From Lanett to Alaga, Ala., mineral content of the water of the Chattahoochee River increases slightly (fig. 11). Mineral content ranged from 34 to 45 ppm (some values were calculated from specific conductance) in the stream during the August survey and from 25 to 39 ppm in April. Water is usually carbonate in type, and about 25 percent of the mineral constituents is silica. Almost no color is present, but the water was turbid during periods of high flow.

Hardley, Oseligee, Osanippa, Halawakee, Wacoochee, Soap, Coch-galechee, and Uchee Creeks are low in mineral content, 12 (33-61 ppm), very soft, 12 (10-30 ppm), and contain almost no color.

Hatchechubbee, Weolustee, Cowikee, Chewalla, and Barbour Creeks are slightly higher in mineral content, 8 (35-86 ppm), than creeks to the north. Water in these streams seems to have been in contact with calcareous rocks. Hardness is higher than that of streams to the north, but water in these streams would be rated as soft.

Cheneyhatchee, Abbie, and Peterman Creeks are lower in mineral content than streams to the north and south. Mineral content in these streams ranges from 22 to 38 ppm, and the water is very soft (less than 25 ppm). Almost no color is present.

Omussee, Cedar, Bryans, Cowarts, and Big Creeks, and Bazemore Lake, as a group are slightly higher in mineral content than other tributaries to the Chattahoochee River. Mineral content in water in these creeks ranges from 39 to 110 ppm. Hardness ranges from 20 to 80 ppm (very soft to moderately hard).

Choctawhatchee, Yellow, and Conecuh Rivers

The headwater streams of the Choctawhatchee River, Yellow River, and Conecuh River are in this area. Plate 1 shows the location of the points in the basin where data on quality of water were obtained.

"These river systems rise in the Coastal Plain in southeastern Alabama and flow southward or southwestward to the Gulf of Mexico. The principal tributary of the Choctawhatchee River is Pea River, entering at Geneva. The Conecuh River (called the Escambia River in Florida) is notable because all of its tributaries enter from the west. Streams in these basins are generally similar in that they meander with low to moderate slopes through broad swampy flood plains, particularly in the

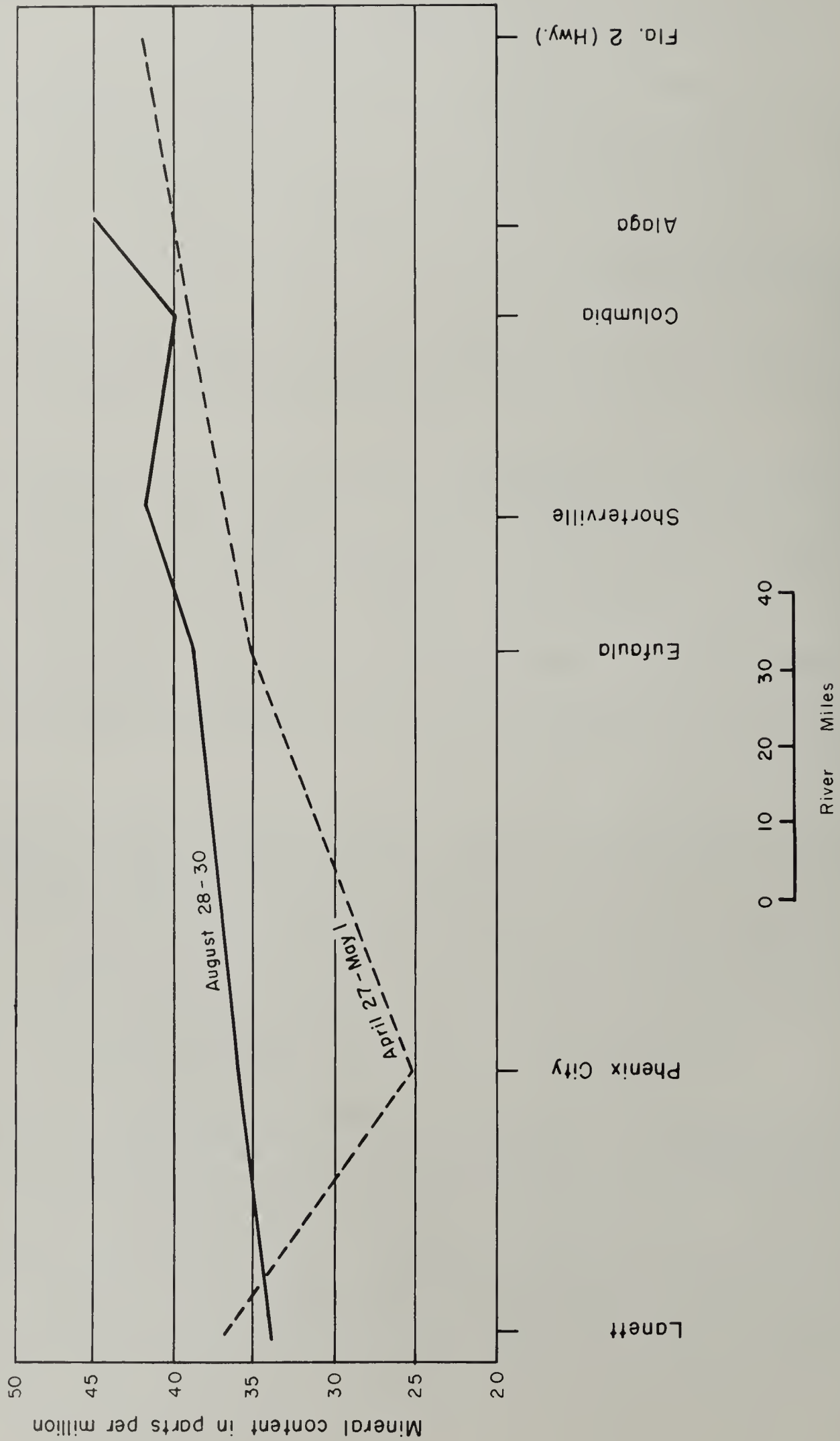


Figure 11. --Mineral content of water of Chattahoochee River during stream surveys on April 27-May 1 and August 28-30, 1960.

Southern Red Hills area." (Peirce, 1954, p. 5).

The Choctawhatchee River begins in Barbour County and flows southward, leaving the State of Alabama near Geneva. At the gaging station near Geneva, the Choctawhatchee River has a drainage area of 1,347 square miles. The maximum discharge was 20,000 cfs, January 21, 1925, and the minimum daily discharge was 232 cfs, September 22, 1925, for 3 years of record from June 1922 through November 1925 (U.S. Geol. Survey, 1960a, p. 212).

The Pea River has its beginning in Bullock County and flows southward, joining the Choctawhatchee River near Geneva, Ala. The Pea River near Samson, Ala., drains an area of 1,187 square miles and has an average discharge for 34 years of record of 1,715 cfs (U.S. Geol. Survey, 1960b, p. 249).

Most of the headwaters of the Yellow River are in Covington County. Near Wing, Ala., which is about 1 mile north of the Alabama-Florida State line, this stream drains an area of 447 square miles. The maximum discharge during the period June 1958 to September 1959 was 3,490 cfs, and on October 29, 30, 1958, the minimum discharge was 165 cfs (U.S. Geol. Survey, 1960b, p. 255).

The Conecuh River begins in Bullock County and flows southwestward, entering Florida near Flomaton, Ala. The Escambia Creeks join the Conecuh River just south of the Alabama-Florida line. The Conecuh River is called the Escambia River in Florida. At Century, Fla., just below the Alabama-Florida State line, the Escambia River drains an area of 3,817 square miles and the average discharge for 25 years of record is 5,989 cfs (U.S. Geol. Survey, 1960b, p. 272).

Sixty-seven samples were collected from 55 different locations in these basins during this study. Analyses of these samples (table 10) were compared with analyses of samples collected during previous studies (Carter and others, 1949, p. 245). This comparison does not indicate any overall change in the chemical quality of water in these streams between the periods of study.

This area is principally rural and has no large concentration of population or any large amount of industrial development. The products from agricultural activities include corn, cotton, and peanuts. Sawmills, textile plants, and meat-packing plants make up most of the industry.

Several cities--Georgianna, Greenville, Evergreen, Flomaton, Brundidge, Ozark, and Samson--obtain their water from underground

supplies. Several cities dispose waste into the surface streams of this area. Some of these cities are: Andalusia, Evergreen, Flomaton, Brundidge, Dothan, and Ozark (Alabama Water Improvement Advisory Commission, 1949, p. 214-215, 225).

The Conecuh River is low in mineral content, 6 (37-46 ppm), and the water is soft, 6 (18-31 ppm). Some color is present but it is usually less than 10 units. The water is carbonate in type but sometimes the silica is the predominant mineral constituent.

Streams in the Yellow River basin are low in mineral content, 8 (11-46 ppm), and soft. The highest color observed was 40 units in Blackwater Creek near Bradley, Ala., September 30, 1960.

Streams in the Choctawhatchee River basin are generally low in mineral content, 28 (21-94 ppm), and soft. The highest mineral content observed in the streams in this basin was 94 ppm in Richland Creek near Brundidge, August 30, 1960. Water in this creek was moderately hard.

Analyses of water from some of the streams in this basin indicated that the water had been in contact with limestone or other calcareous rocks. Although mineral content was low, the predominant mineral constituents were calcium and bicarbonate. Generally the water in the upper reaches of these streams is higher in mineral content than water farther downstream in the basin. Color in water of the streams is higher in the downstream tributaries.

Coosa River

The headwater streams of the Coosa River are in the Blue Ridge Mountains of Georgia. The Oostanaula and Etowah Rivers converge near Rome, Ga., to form the Coosa River. The Coosa River enters Alabama near Cedar Bluff and flows southwestward to join the Tallapoosa River near Montgomery, Ala. At the gaging station near Wetumpka, Ala., which is above the confluence of the Coosa and Tallapoosa Rivers, the Coosa River drains an area of 10,200 square miles and the average discharge for 35 years of record (1912-14, 1926-59) is 15,810 cfs (U.S. Geol. Survey, 1960b, p. 314). The flow of this stream is regulated by several reservoirs and hydroelectric plants.

During this study 69 samples were collected from 43 different data-collection locations within the basin. Plate 1 shows the location of the data-collection points in this basin. The analyses of these samples were compared with a few analyses of samples collected during prior investigations (Peirce and Brown, 1955, p. 254-257). This comparison did not indicate any overall change in quality.

The Coosa River basin is both an agricultural and an industrial area. Some of the agricultural products include cotton, corn, cattle, and dairying. Some of the industrial activities include the production and processing of steel and steel products, textiles, and chemicals. The leading industrial communities are Anniston, Gadsden, Sylacauga, and Talladega.

Gadsden uses the Coosa River as a source of its water supply. The treatment includes prechlorination, coagulation with alum and lime, sedimentation, filtration, postchlorination, and pH adjustment.

The headwaters of the Coosa River are low in mineral content and soft. As the streams flow into the Valley and Ridge province, they contact relatively soluble rocks and, as a consequence, their mineral content increases.

The mineral content of the Coosa River where it enters Alabama is about 85 ppm during low flow (fig. 12). The water is carbonate in type and soft. Below Gadsden the mineral content of the river begins to increase, reaching a maximum (122 ppm) near Childersburg. This increase in mineral content from Gadsden to Childersburg is probably in part due to industrial and municipal wastes and in part due to the relatively high mineral content of tributary streams in this reach of the river. Many of the tributary streams are underlain by limestone and dolomite.

The mineral content of the river during high flow is nearly uniform from near where it enters the State to its confluence with the Tallapoosa River. The uniform mineral content is due to the stabilizing effect of reservoirs.

Coosa River water has almost no color. The pH ranged from 7.3 to 8.1 during the April reconnaissance and from 6.7 to 7.5 during the August reconnaissance. This river is often turbid during high flow.

The Chattooga River and Spring Creek near Cedar Bluff have relatively high mineral contents, 4 (118-181 ppm). These streams are moderately hard to hard and have no color. The observed pH was 7.6 and 7.9.

Little River near Cedar Bluff drains relatively insoluble rocks, therefore its mineral content is low (14 ppm). It is soft and contains less than 10 units of color.

Big Wills Creek receives much of its water from areas underlain by dolomite. The water of this stream ranges from moderately hard to

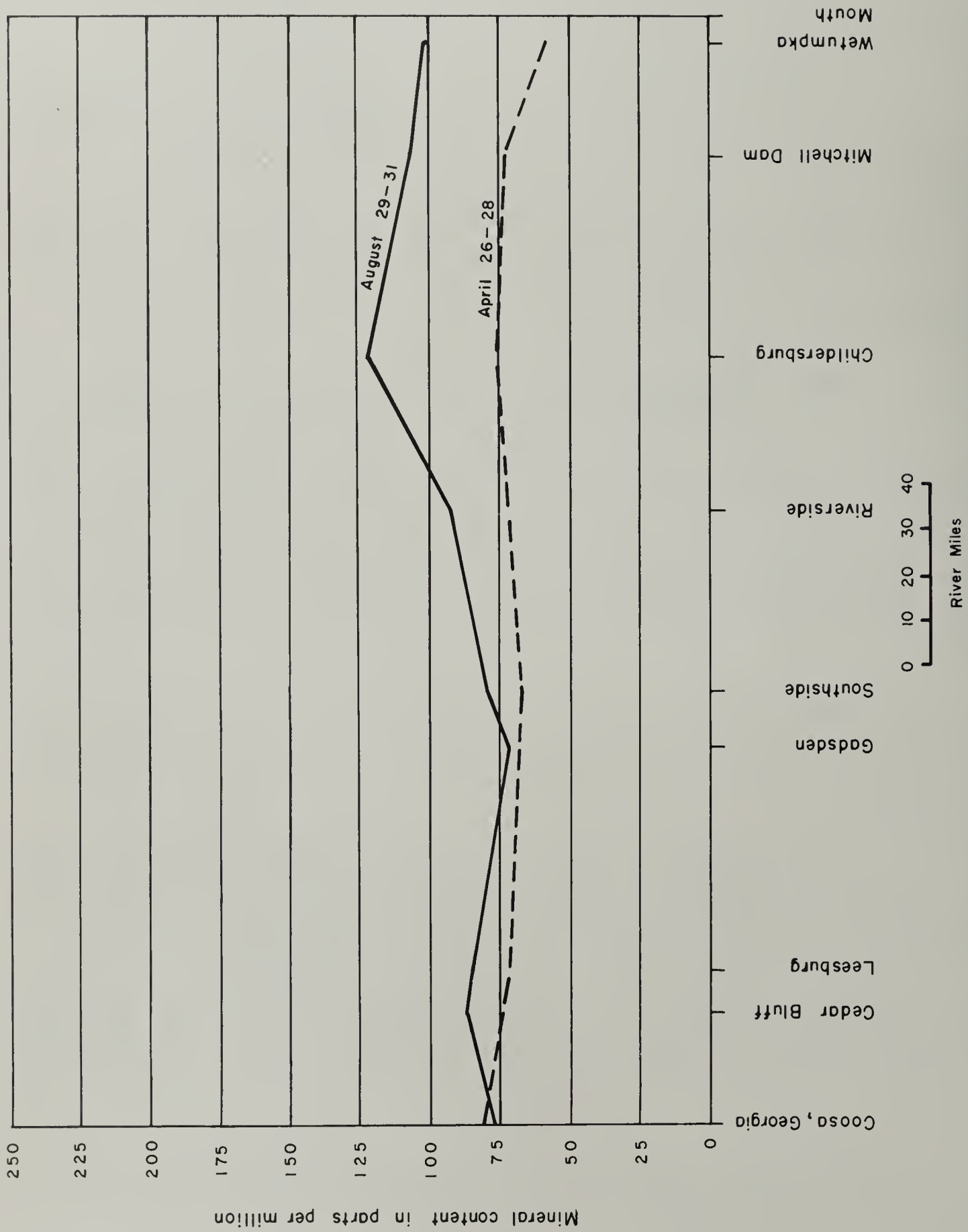


Figure 12. -- Mineral content of water of Coosa River during stream surveys on April 26-28 and August 29-31, 1960.

hard, 5 (94-130 ppm). The calcium to magnesium equivalents per million ratio is commonly about 3 to 1. The water is clear.

Black Creek receives waste from industry. Black Creek, above the junction with Big Wills Creek, contained a black suspended material and had a mineral content of approximately 188 ppm on April 26, 1960. The pH of the water was 4.6. Big Wills Creek just below the mouth of Black Creek (Highway 411) was black and had an oily scum adjacent to the Black Creek inflow but was clear and had no scum on the opposite side.

Big Canoe Creek has a relatively high mineral content, 5 (100-124 ppm). The water is moderately hard and the pH ranges from 7.3 to 7.9. The water contains almost no color.

Beaver Creek has a mineral content of about 173 ppm and is hard.

Shoal Creek and Broken Arrow Creek were low in mineral content, soft, and contained almost no color during the April reconnaissance. Broken Arrow Creek had a relatively high mineral content during the August reconnaissance. Sodium concentration was greater than 20 ppm, which seems to be abnormally high for this area. No attempt was made to determine the cause of the higher mineral content or the high sodium content.

Chocolocco Creek rises on the east side of Anniston, near Chocolocco. The headwaters of this creek near Chocolocco are moderately hard, colorless, and relatively high in mineral content (84 ppm). Snow Creek, which enters Chocolocco Creek near Oxford, is one of the most mineralized streams in the State. The mineral content in this stream was 1,040 ppm on August 30, 1960. The waters were white and turbid, hardness was 524 ppm, and sodium exceeded 10 ppm. Chocolocco Creek is more mineralized below Snow Creek than above, owing to the high mineralization of Snow Creek. Chocolocco Creek near Oxford (Highway 21) had a mineral content of 463 ppm and a hardness of 270 ppm on August 30, 1960.

Coldwater Spring, the source of the Anniston water supply, discharges into Chocolocco Creek. The water from this spring seems to be fairly constant in mineral content. The mineral content of a sample taken in 1951 was 118 ppm (Lohr and Love, 1954, p. 51). The mineral content of three samples taken during 1956 and 1957 ranged from 104 to 109 ppm, while mineral content during this study (2 samples) was 116 and 118 ppm. The pH of this water is about 8.0. The water is moderately hard and contains almost no color.

Cheaha Creek, which drains the general area of Mount Cheaha, the highest point in Alabama, had a relatively high mineral content (134 ppm) on August 30, 1960. The water is moderately hard and contains less than 10 units of color. However, the mineral content of Choccolocco Creek below Cheaha and Coldwater Creeks is less than that observed near Oxford. On August 31, 1960, observed values for Choccolocco Creek near Lincoln were: mineral content 191 ppm, hardness 144 ppm, sodium 14 ppm, and chloride 48 ppm. This high mineral content, relatively high sodium and relatively high chloride are probably the result of wastes from the Anniston area.

Kelly Creek, Bear Creek, and Wolf Creek receive most of their water from areas underlain by relatively insoluble rocks. The mineral content of these streams is low, 5 (26-54 ppm). Their waters are soft and contain almost no color.

Talladega Creek is the source of water for Talladega. This stream supplies a population of about 14,500 (U. S. Geol. Survey, 1954, p. 66). This stream has a relatively high mineral content, is moderately hard, and contains almost no color. Three samples taken during the survey had mineral contents of 87, 102, and 137 ppm.

Tallasseehatchee Creek is more mineralized than most streams in the Coosa River basin. The water is hard but contains almost no color. The analysis of the water indicates that this stream is receiving wastes. Sodium was higher in this stream than in other streams of the area.

Walnut Creek is relatively high in mineral content and soft. The water contains almost no color. Hatchet Creek, Topuske Creek, Swamp Creek, Chestnut Creek, Sandy Creek, and Mortar Creek receive their water from areas underlain by insoluble rocks and are therefore low in mineral content. The mineral content of 13 samples collected during the survey ranged from 18 to 40 ppm. The water is soft and contains almost no color.

Tallapoosa River

The Tallapoosa River rises in the Piedmont Upland section of Georgia. It enters Alabama near Heflin and flows southward, joining the Coosa River near Montgomery, Ala.

The Tallapoosa River below Tallassee, Ala., drains an area of 3,320 square miles. The average discharge for 31 years of record is 4,625 cfs, unadjusted (U. S. Geol. Survey, 1960b, p. 319).

During this study 44 samples were collected from 29 different locations. The locations at which data on the quality of water were obtained during the present study are shown in plate 1. Analyses of these samples were compared with the analyses of a few samples collected during previous studies. The comparison did not indicate any overall change in water quality.

Several cities in this basin receive their water from streams in the Tallapoosa basin. Alexander City uses the water of Hillabee Creek, Auburn uses Moores and Chewalala Creeks, and Opelika uses water of the Sougahatchee Creek (Alabama Water Improvement Advisory Commission, 1949, p. 119).

Most of the area drained by the Tallapoosa River is underlain by crystalline rocks. The lower reaches, below Tallassee, drain an area underlain by sedimentary rocks of the Coastal Plain province. The sand, clay, and gravel in this area of the Coastal Plain tend to be insoluble in water.

The water of the Tallapoosa River from headwater to terminus is low in mineral content. The highest mineral content observed during either stream survey was 34 ppm. The lowest mineral content observed during either survey was 25 ppm. The water is usually siliceous in type. There is almost no color in the water. Figure 13 shows the mineral content at various points during stream surveys.

There are three dams used to store water and to generate hydroelectric power: Martin dam, Yates dam, and Thurlow dam. The storing of water of low mineral content during periods of high flow and release of this water during periods of low flow enhance the quality of water in this basin.

Cahulga Creek, Mad Indian Creek, Little Tallapoosa River, Piney Wood Creek, Wedowee Creek, Fox Creek, Crooked Creek, Wesobulga Creek, Cedar Creek, High Pine Creek, Town Creek, Emuckfaw Creek, and Buck Creek drain areas underlain by crystalline rocks. These streams are generally siliceous in type, low in mineral content, 23 (17-76 ppm), and soft. None of the streams appear to be significantly influenced by cultural activities.

The mineral content of Sougahatchee Creek near Reeltown was 76 ppm in April and 222 ppm in August 1960. The mineral content in August was considerably higher than in other streams in this river basin. According to the Alabama Water Improvement Advisory Commission (1949, p. 121), Pepperell Branch, a tributary to Sougahatchee Creek, receives sewage and industrial waste. These sewage and industrial wastes in

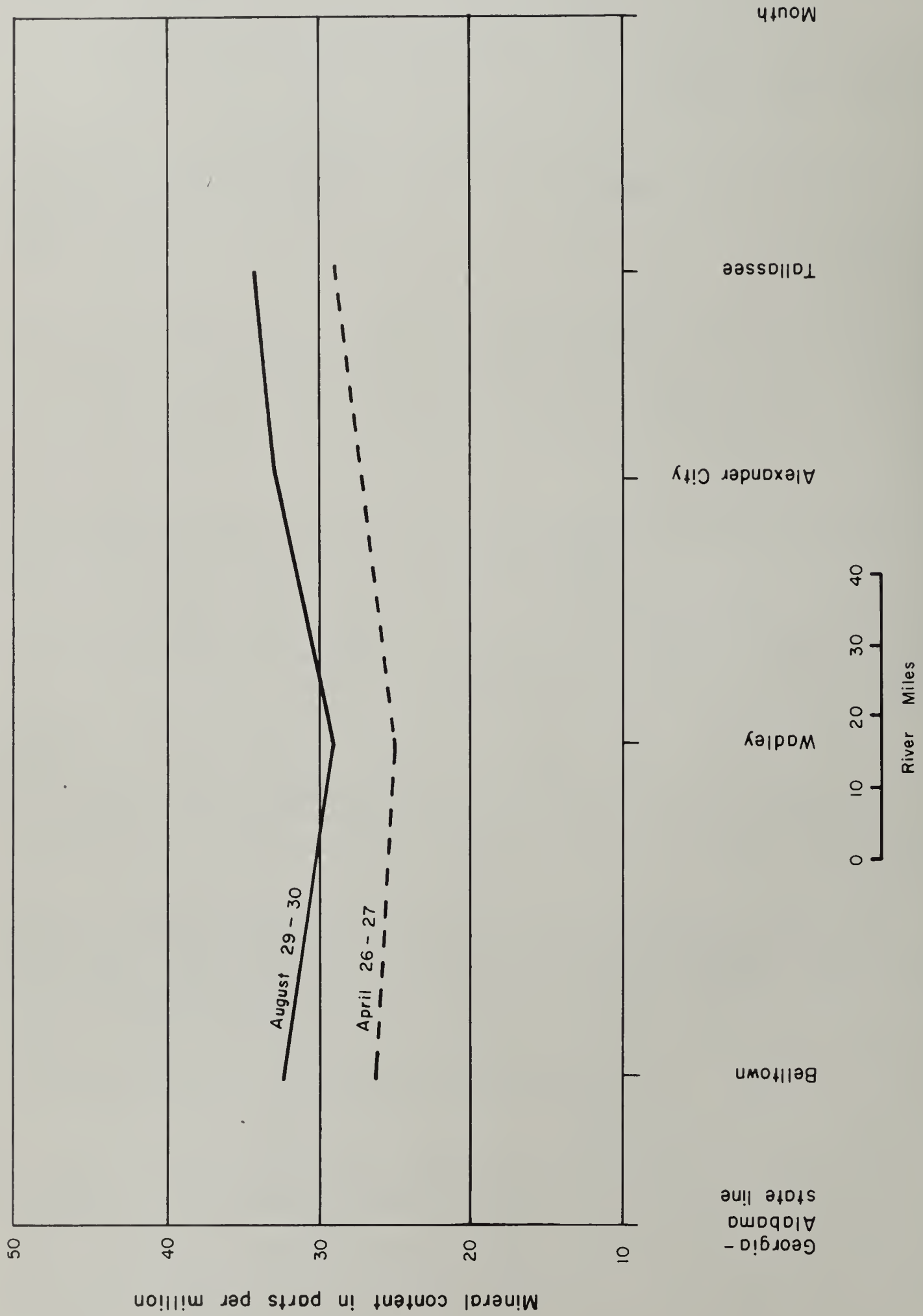


Figure 13. --Mineral content of water of Tallapoosa River during stream surveys on April 26-27 and August 29-30, 1960.

Pepperell Branch could account for the higher mineral content observed in Sougahatchee Creek. The headwaters of the Sougahatchee Creek are used by Notasulga and Opelika as a water supply.

Uphapee Creek was sampled near Tuskegee. The water of this creek is carbonate in type, low in mineral content, 3 (33-50 ppm), and contains almost no color. The water supply for the city of Tuskegee is obtained from the Uphapee Creek, approximately 23 miles below the sewers outfalls at Auburn (Alabama Water Improvement Advisory Commission, 1949, p. 122).

Chinquapin Creek, a tributary to Uphapee Creek below Tuskegee, is low in mineral content, soft, and contains some color. Calebee Creek near Tuskegee is carbonate in type, low in mineral content, and soft. Line Creek is carbonate in type and relatively high in mineral content (120 ppm). The water is moderately hard and contains some color. Gubahatchee Creek is low in mineral content (53 ppm) and soft. On August 29, 1960, the water contained 27 units of color. Two samples were collected from Chinquapin Creek and two from Calebee Creek. The mineral content was 32 and 34 ppm and 46 and 52 ppm, respectively.

Alabama River

The Alabama River is formed at the confluence of the Coosa and Tallapoosa Rivers near Montgomery, Ala. It flows southward to near Malcolm, Ala., where it is joined by the Tombigbee River to form the Mobile River.

At Claiborne the Alabama River drains an area of approximately 22,000 square miles and the average discharge for 29 years of record is 31,230 cfs. The flow of this stream is regulated by Allatoona Reservoir, Lake Martin, and Coosa River reservoirs (U.S. Geol. Survey, 1960 b, p. 337).

During this study 70 samples were collected for analysis from 53 different locations. The location of these data-collection points is shown in plate 1.

The analyses of samples collected during this study were compared with the analyses of samples collected during previous studies (Alabama Water Improvement Advisory Commission, 1949, p. 154-169). The comparison does not show any overall change in water quality.

The mineral content of the Alabama River at Montgomery depends largely on the relative flow in the Coosa and Tallapoosa Rivers. The

flow of both rivers is affected by storage in reservoirs, Jordan on the Coosa River and Thurlow on the Tallapoosa River. Waters of the Coosa River are generally higher in mineral content than those of the Tallapoosa River. Too, the average discharge of the Coosa River is about three times that of the Tallapoosa River. The mineral content of the Coosa River during the April survey ranged from 59 ppm to 79 ppm, whereas the mineral content in the Tallapoosa River ranged from 25 ppm to 29 ppm. The mineral content in the Coosa River during the August survey ranged from 72 ppm to 122 ppm and the mineral content in the Tallapoosa River ranged from 29 ppm to 34 ppm. Figure 14 shows the mineral content at points in the river during stream surveys.

The Alabama River just below the confluence of the Coosa and Tallapoosa Rivers had a mineral content of 51 ppm in April and 52 ppm in August. This mineral content, which is higher than the mineral content in the Tallapoosa River and lower than that in the Coosa River, is a result of the mixing of waters from these two rivers.

During the spring survey there was very little change in the mineral content of the Alabama River from Montgomery to its mouth. During the August survey there was an increase in mineral content (from 52 to 86 ppm) between Montgomery and Selma. This increase may be due in part to inflow of mineralized ground water and in part to industrial and municipal wastes. From Selma to Claiborne there was a general decrease in mineral content.

Several cities dispose of their waste products into the Alabama River or its tributaries. Some of the cities are: Camden, Frisco City, Monroeville, Montgomery, Prattville, and Selma (Alabama Water Improvement Advisory Commission, 1949, p. 151). Part of the increase in mineralization between Montgomery and Selma may be due to waste disposals.

Pine Creek near Montgomery is low in mineral content (29 ppm), soft, and low in color.

Pintlalla, Catoma, Swamp, and Soapstone Creeks are relatively high in mineral content. The mineral content in Big Swamp Creek was 243 ppm on April 29, 1960. These streams may have as much as 20 units of color.

Mulberry Creek and Valley Creek are low in mineral content, 2 (28-54 ppm), and color and are soft.

The Cahaba River has its beginning near Birmingham. It flows southward, joining the Alabama River just below Selma. At Spratt, it drains an area of 1,378 square miles and the average discharge for 15

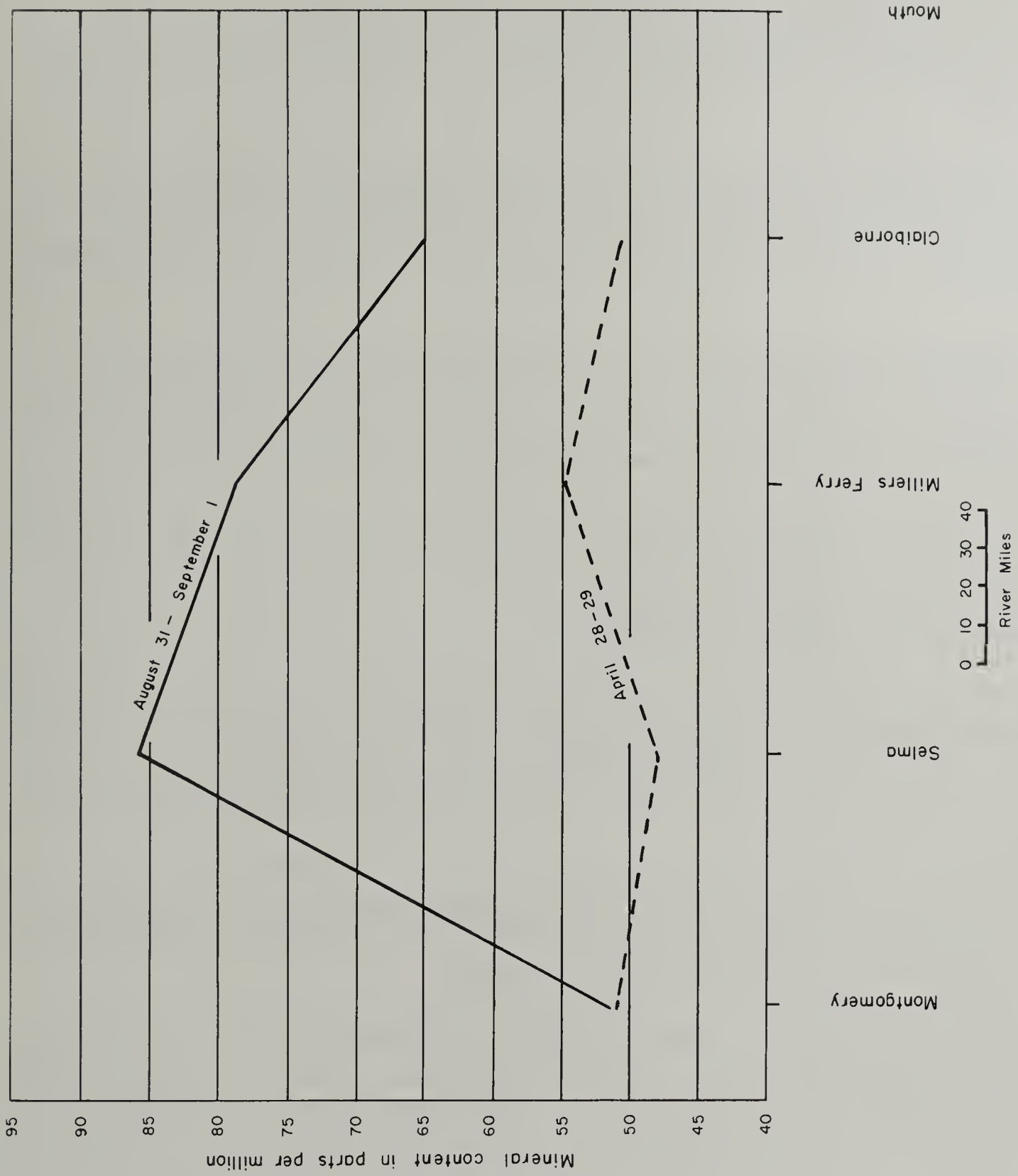


Figure 14. --Mineral content of water of Alabama River during stream surveys on April 28-29 and August 31-September 1, 1960.

years of record is 2,025 cfs (U.S. Geol. Survey, 1960b, p. 330). Lake Purdy on the Cahaba River is a source of water for the Birmingham municipal system.

The Cahaba River in the Trussville area is relatively high in mineral content, 2 (89-128 ppm), and is relatively hard. It is almost free of color and sulfate. Near Lovick the mineral content is greater, 2 (163-191 ppm), than at Trussville and sulfate content is among the highest observed in the State. Sulfate was 70 and 79 ppm in the two samples collected.

The Little Cahaba River enters the Cahaba River below Lovick. It is relatively high in mineral content (150 ppm) and the water is hard. There is almost no sulfate present in this stream. The water has almost no color.

The mineral content of the Cahaba River decreases between Lovick and Homewood but increases significantly between Homewood and Acton. The change in mineral content is due mostly to changes in the sodium and sulfate. The reason for these changes was not determined.

Dilution of the Cahaba River by tributary inflow of low mineral content causes a gradual decrease in the mineralization of the Cahaba River between Acton and the mouth. The mineral content near Beloit on September 1, 1960, was 98 ppm.

The waters of Mahan Creek and Shultz Creek are relatively high in mineral content, 2 (112-119 ppm), and moderately hard. Six Mile Creek, Haysop Creek, Childers Creek are relatively high in mineral content, 3 (53-60 ppm), and soft. There is almost no color in the water of these streams.

Old Town, Affonee, Blue Outtee, Taylor, Goose, Wells, Water, and Oakmulgee Creeks are low in mineral content, 10 (15-49 ppm). The waters are soft and contain almost no color.

Boguechitto, Bear, Chilatchee, Prairie, Pine Barren, and James Creeks are relatively high in mineral content, 8 (66-197 ppm). The waters of these creeks are usually moderately hard but occasionally may be hard. There is usually some color present in these streams.

Sturdivent, Turkey Creek near Pineapple, Shomo, and Butterfork Creeks, Little River, Turkey Creek near Blacksher, and Holley Creek are very low in mineral content, 7 (13-34 ppm). Generally these streams contain some color. A color of 90 units was observed in Turkey Creek near Pineapple on September 1, 1960. The waters of these creeks are

very soft, usually less than 10 ppm; silica generally is the principal constituent.

Tombigbee River

The Tombigbee River rises in northeast Mississippi, enters Alabama in the west-central part of the State, flows southward, and joins the Alabama River to form the Mobile River.

The Tombigbee River, at Alabama River cutoff, drains an area of approximately 20,000 square miles. Near Leroy it drains an area of approximately 19,100 square miles, and the average discharge for 31 years of record is 26,260 cfs. At low flow locks and dams offer some regulation (U.S. Geol. Survey, 1960b, p. 394).

During this study 66 samples of water were collected for analysis from 52 different data-collection points in the basin (pl. 1). The analyses were compared with analyses of samples collected during prior studies (Peirce, 1959, p. 228-233; Alabama Water Improvement Advisory Commission, 1949, p. 35-41, 79-84). This comparison does not indicate any overall change in chemical quality between these periods of study.

Some cities that receive their water supplies from surface sources are Boston, Fayette, Haleyville, Bellamy, Livingston, and York. Several cities dispose of their wastes into the Tombigbee River or its tributaries. Some of the cities disposing of waste into the Tombigbee River or its tributaries are: Aliceville, Fayette, Hamilton, Bellamy, Butler, Demopolis, and Jackson (Alabama Water Improvement Advisory Commission, 1949, p. 32-33, 75-76).

Most data collected during this study in the Tombigbee River basin were collected in the August 1960 survey. Therefore most of the following discussion concerns quality of water in the river at that time.

At Gainesville, on August 31, 1960, water of the Tombigbee River was relatively low in mineral content (52 ppm), carbonate in type, and soft. Color was 6 units. Almost no change occurs in the quality of water as it flows downstream to Epes (fig. 15). Mineral content at Epes, September 1, 1960, was 51 ppm. At Coatopa below the confluence of the Tombigbee and Black Warrior Rivers, mineral content increased to 92 ppm. Most of this increase is attributed to the influence of relatively high mineralization in the Black Warrior River. At Eutaw on the same day, mineral content of the Black Warrior River was 103 ppm. An insufficient quantity of data prevents an estimate of the influence on mineralization in the Tombigbee River by mineralization in the Black Warrior River.

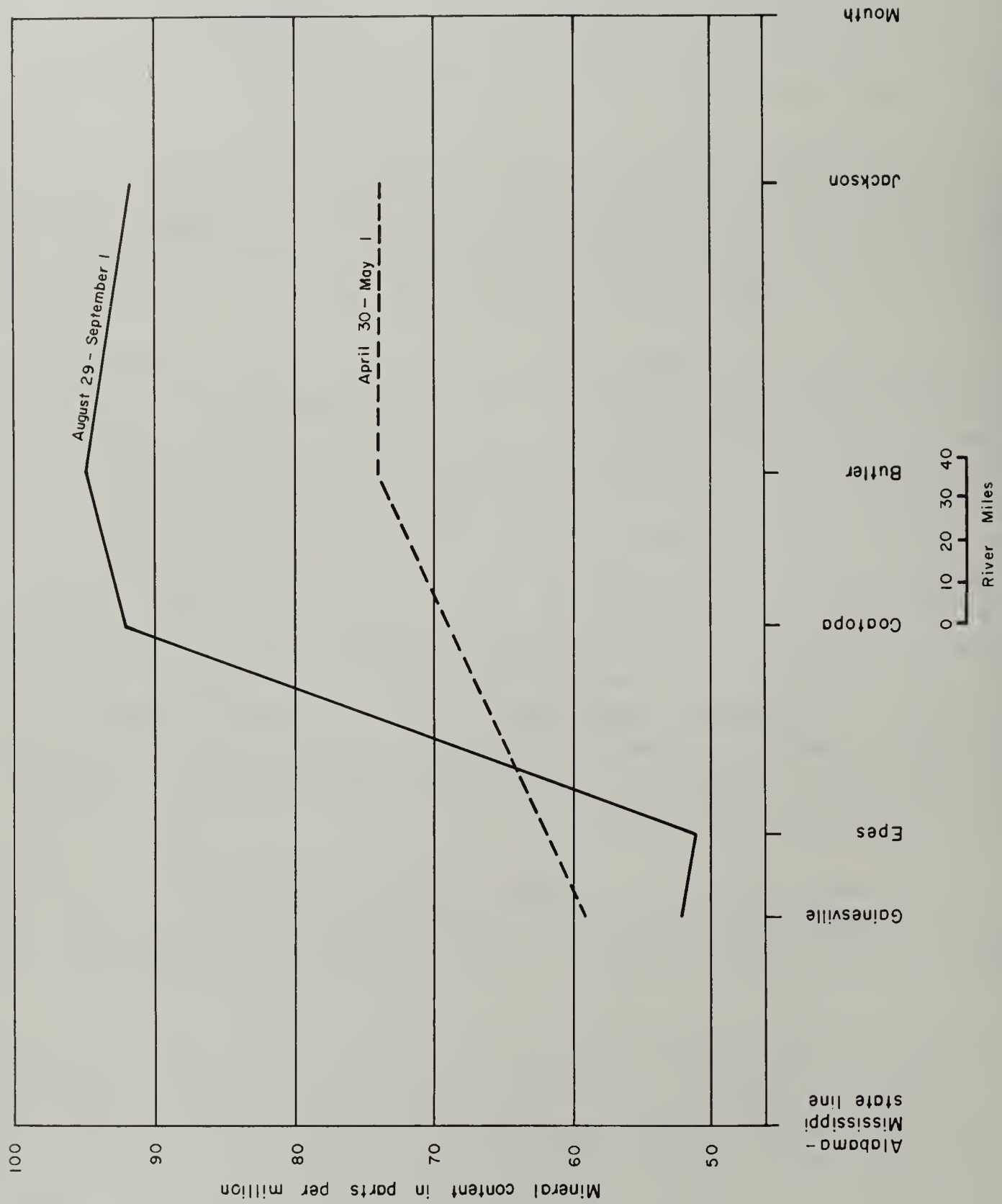


Figure 15. --Mineral content of the Tombigbee River during stream surveys on April 30-May 1 and August 29-September 1, 1960.

Below Coatopa the Tombigbee River is relatively constant in mineral content (fig. 15).

Bull Mountain, Buttahatchee, Beaver, Coalfire, and Lubbub Creeks and the Sipsey River are low in mineral content, 14 (14-61 ppm), and soft, 14 (5-23 ppm). The highest color was 36 units in Lubbub Creek, August 31, 1960. The water is siliceous. Highest mineral content, 61 ppm, was in the Sipsey River at Fayette. This mineral content, which is higher than that above or below the town, seems related to cultural activities.

The drainage basin of Tubb Creek is in an area underlain by the Selma Group. Water in this stream is more mineralized than water in Trussells and Brush Creeks. Samples for analysis collected in Trussells and Brush Creeks were collected upstream from the area of more soluble rocks. Mineral content in Tubb Creek on August 31, 1960, was 104 ppm. The water was moderately hard and low in color. Water in Trussells and Brush Creeks is soft, 3 (14-26 ppm). Highest mineral content in these streams was 59 ppm in Trussells Creek, August 31, 1960.

Kinterbish Creek near Ward was low in mineral content (28 ppm) and soft (14 ppm), and color was 27 units on September 1, 1960.

Sucarnoochee River and Double, Tuckabum, Yantley, Horse, Sweetwater, Vaughn, Wahalak, Bogueloosa, Souwilpa, Mill, Satilpa, E. Bassett, Jackson, and Stave Creeks are relatively high in mineral content, 19 (35-103 ppm). Most waters have mineral contents greater than 60 ppm. Color is generally less than 20 although one sample had a color of 23 and another 80 units. Water ranges from soft to moderately hard.

Coatopa Creek, Chickasaw Bogue, Okatuppa, Little Souwilpa, Turkey, and Dunbar Creeks contain the most highly mineralized water in the Tombigbee River basin. Mineralization in these streams ranged from 106 ppm in Turkey Creek to 194 ppm in Chickasaw Bogue. Okatuppa Creek had the highest mineral content of any stream investigated in the Tombigbee River basin. This stream is not included in the range of mineral content above because it seems definitely influenced by cultural activities. On September 1, 1960, mineral content was about 684 ppm. May 1, 1960, mineral content was considerably lower, 156 ppm. Chloride was the principal mineral constituent in May, but chloride was not determined in the September sample. This high mineral content may be due to oil field wastes; however, no attempt was made to determine the source of the high mineralization. The remainder of these streams do not seem significantly influenced by cultural activities. Analysis indicates that the water had been in contact with limestone. Principal mineral constituents are bicarbonate and those contributing to hardness. Some of these streams have a hardness as high as 180 ppm; the color is less than 20 units.

Waters of Poll Bayou, Taylor, Little Bassett, West Bassett, Armstrong, Lewis, Bilbo, and Bates Creeks are less mineralized than most streams in the State. Mineral content in these streams ranges from 14 to 31 ppm. Highest hardness was 9 ppm. However, most of these streams were slightly colored. The stream having the lowest color is Armstrong Creek (8 units); the stream having the highest color is Poll Bayou (65 units).

Black Warrior River

The Black Warrior River begins in the Cumberland Plateau section of the Appalachian Plateaus province of Alabama. It is formed at the confluence of Mulberry Fork and Locust Fork, then flows southwestward, joining the Tombigbee River at Demopolis, Ala.

The Black Warrior River at Tuscaloosa, Ala., about 60 miles upstream from its junction with the Tombigbee River, drains an area of 4,828 square miles and the average discharge for 39 years of record is 7,657 cfs (U.S. Geol. Survey, 1960b, p. 383).

The Black Warrior River basin is the most highly industrialized basin in the State. Coal and iron ore mining, steel production, processing of steel products, chemicals, textiles, oil refining, and wood preserving are the major industries. An estimated 90 percent of the coal and iron produced in Alabama comes from the Warrior basin. Several communities, Barney Mines, Birmingham, Bradford, Cullman, Jasper, Albertville, Arab, and Eutaw dispose of their waste into streams of the Black Warrior River basin.

During this study 47 samples were collected for analysis from 37 data-collection points (pl. 1). These analyses were compared with analyses of samples collected from previous studies (Peirce, 1959, p. 228-233; Alabama Water Improvement Advisory Commission, 1949, p. 52-73). This comparison does not indicate any overall change in the chemical quality of streams in this basin.

The Black Warrior River was sampled at three locations: Tuscaloosa, Fosters Ferry Bridge, and near Eutaw. Therefore, most of the 47 samples were collected either from the headwater streams or the tributary streams. The headwater streams are discussed first, followed by discussion of the tributaries downstream to Tuscaloosa, the Black Warrior at Tuscaloosa, the tributaries between the Tuscaloosa station and the Fosters Ferry Bridge station, then the tributaries from Fosters to the mouth of the river.

The water of Mulberry Fork, near Holly Pond, is low in mineral

content, soft, and contains almost no color. On April 28, 1960, the mineral content was 26 ppm. On August 29, 1960, the mineral content was 34 ppm and increased to 69 ppm near Garden City. Duck Creek, a tributary entering Mulberry Fork above Garden City, is low in mineral content, 2 (23-30 ppm), and very soft.

Sipsey Fork, a tributary to Mulberry Fork, is low in mineral content, soft, and the color is less than 5 units. West Fork Sipsey Fork, Clifty Fork, and Clear Creek were low in mineral content, 5 (18-44 ppm), and soft, 5 (8-26 ppm).

Blackwater Creek was low in mineral content and soft and the color is very low. Sulfate is the principal mineral constituent in this stream. Lost Creek and Wolf Creek near Oakman were more highly mineralized than other streams in the area. Mineral content in Lost Creek on August 30, 1960, was 111 ppm. Mineral content in Wolf Creek was 148 ppm.

The water of Locust Fork is more highly mineralized than the water of Mulberry Fork. Calvert Prong, a tributary to Locust Fork, had a mineral content of 191 ppm August 29, 1960. Locust Fork had a mineral content of 124 ppm at Powhatan, of which 50 ppm was sulfate. Water of this stream was moderately hard and it contained very little color (2 units).

Mud Creek, a tributary stream draining areas in and around Bessemer, is one of the most highly mineralized streams in the area. Mineral content near Oak Grove was 413 ppm April 29, 1960, and 440 ppm August 29, 1960. Sulfate was the principal mineral constituent during both surveys, 235 ppm in April and 236 ppm in August. The water was hard.

Yellow Creek and Blue Creek are low in mineral content, 3 (20-44 ppm), soft, and low in color.

Hurricane Creek is more mineralized than Yellow Creek and Blue Creek but less than Mud Creek. Near Holt, the mineral content was 53 ppm on April 29 and 77 ppm on August 29. Sulfate was not determined on the April sample, but it was the principal mineral constituent in August.

North River, Turkey Creek, and Binnion Creek are low in mineral content, 4 (12-24 ppm), and soft. Silica is one of the principal mineral constituents in the water of the North River.

At Tuscaloosa the Black Warrior River has a relatively high mineral content, 73 ppm in April and 144 ppm in August 1960. The water

was of sulfate type during both surveys. The presence of sulfate may be due in part to waste from coal mining activities. Mineral content at Fosters Ferry Bridge was 101 ppm on September 1, 1960. The water at this point was sulfate in type, moderately hard, and color was less than 5 units.

Big Sandy Creek was sampled at Duncanville and near Moundville during the August survey. At Duncanville the mineral content was 104 ppm and near Moundville, 65 ppm. Therefore, headwaters of the stream are more mineralized than points downstream. The water is moderately hard in the Duncanville area and soft at Moundville. The headwaters of this stream are in the area of limestone and dolomite and the downstream reaches are in sand, clay, and gravel. This could account for the occurrence of more mineralized water in the upper reaches.

Grant, Elliot, Back, Sims, Davis, and Fivemile Creeks are low in mineral content, 6 (14-41 ppm), and soft, 6 (8-22 ppm).

The Black Warrior River is less mineralized near Eutaw than at Tuscaloosa. Mineral content was 69 ppm in April and 103 ppm in August. The water is sulfate in type and soft. Tributary inflow in this area tends to dilute the water of the Black Warrior River.

Big Prairie Creek near Gallion and Little Prairie Creek near Cedarville were more mineralized than Grant, Elliot, Back, Sims, Davis, and Fivemile Creeks. Prairie Creeks had a mineral content of 168 ppm (Big Prairie) and 197 ppm (Little Prairie). Sodium was greater than 10 ppm in these streams. This indicates cultural influence because most other streams in this area had less than 5 ppm sodium. The water of these creeks was carbonate in type and moderately hard.

Mobile River

The Mobile River, as used in this report, includes the Mobile River, Escatawpa River, and the Mobile Bay area. The Mobile River is formed at the confluence of the Alabama and Tombigbee Rivers. The Mobile River, at Mount Vernon, drains an area of approximately 43,000 square miles (U.S. Geol. Survey, 1957, p. 50).

The Escatawpa River, near Wilmer, Ala., drains an area of 506 square miles, and the average discharge for 14 years of record is 981 cfs (U.S. Geol. Survey, 1960b, p. 410).

This area has a higher average annual rainfall than any other area in the State. It is primarily an industrial area although some truck farming and cattleraising are conducted. Mobile is one of the largest

ports on the gulf coast, and shipping is one of the major industries of the State. Oystering, fishing, ship repair, shipbuilding, and chemicals are major industries.

The Mobile River is the entrance to the Black Warrior-Tombigbee Waterway. This waterway is one of the most important water routes in the southeast.

Plate 1 shows the approximate location of data-collection points for the streams in this area.

The Mobile River near Mount Vernon represents a mixture of the Tombigbee and Alabama Rivers. The mineral content is relatively high, 2 (66-97 ppm). The water is soft and contains almost no color.

Styx River is a tributary to the Perdido River. Water of the Styx River is very low in mineral content, 2 (24-28 ppm), and soft. The color was 12 and 22 units in two samples.

The Perdido River is very low in mineral content (16 ppm). The water is very soft and colored.

Pine Log Creek, Borrow Creek, Farris Creek, Halls Creek, Bayou Sara, and Halls Mill Creek are very low in mineral content and soft. The streams contain color, 6 (7-32 units).

Cedar Creek was higher in mineral content than most of the streams in this general area. The mineral content was about 63 ppm. The sodium was greater than 10 ppm and this indicates cultural influences.

Chickasaw Creek contained the highest observed mineral content of any stream in the area except the Fish River near Yupton. The mineral content near Chickasaw on September 2, 1960, was 1,110 ppm. Sodium and chloride were the principal mineral constituents.

Fish River near Silver Hill is very low in mineral content, 2 (18-19 ppm), and very soft. The hardness was 3 ppm in April and 4 ppm in September 1960. The water of Fish River near Yupton is brackish. The mineral content on September 2, 1960, was about 6,200 ppm. The principal mineral constituents were sodium and chloride.

Magnolia River, West Fowl River, Escatawpa River, Pasture Creek, Miller Creek, Johnson Creek, and Franklin Creek were very low in mineral content, 9 (15-26 ppm), and very soft, 9 (4-14 ppm). The streams contained some color, 9 (3-25 units).

Tennessee River

The Tennessee River is formed by the confluence of the French Broad and Holston Rivers near Knoxville, Tenn. It flows southward through Chattanooga, Tenn., and enters the northeast corner of Alabama. The river then flows southwestward, turns to the northwest near Guntersville, Ala., and leaves the State at the northwest corner. At Florence, Ala., the Tennessee River has a drainage area of approximately 30,810 square miles, and the average discharge, based on 65 years of record (1894-1959), was 50,640 cfs (U.S. Geol. Survey, 1960c, p. 191).

The Tennessee River is made navigable by a series of locks and dams. The reservoirs formed by the dams, in addition to providing excellent fishing, swimming, and boating opportunities, improve the chemical quality of the water. "The abundant natural supply of water in the streams is enhanced by many large storage reservoirs on the principal tributaries of the Tennessee River. These not only serve to augment the low flow but exert a beneficial influence on the quality of water passing through them. The water released from the reservoirs is generally clearer, colder, and more uniform in quality than the inflowing water. The reservoirs along the main Tennessee River also augment the low flows and improve the quality of water passing through them to some extent. However, their clarifying action is not as complete as that of the storage reservoirs, and they have but little effect on water temperature." (Tennessee Valley Authority, 1948, p. 1).

The temperature of water at various points in the river, measured at about monthly intervals by the Tennessee Valley Authority, ranged from 42°F, February 17, 1947, to 82°F, August 16, 1946.

During this study, data were obtained from 44 data-collection points in the Tennessee River basin (pl. 1). Thirty-seven of these points are on tributaries of the Tennessee River, seven are on the Tennessee River. A total of 53 samples were collected from streams in the basin. The analyses of these samples were compared with the analyses of samples collected during prior studies (Tennessee Valley Authority, 1948). The results of comparison show no overall change in the water quality between the two periods of study. The quality of water in the Tennessee River can be considered good (mineral content less than 500 ppm) for most purposes.

The Tennessee River in its upper reaches is a mixture of water from the French Broad and Holston Rivers. The mineral content varies with the quantity of flow released from Douglas Reservoir on the French Broad River and from Cherokee Reservoir on the Holston River. When the flow is from Douglas Reservoir alone, the water is relatively soft.

On the other hand, when Douglas Reservoir is shut off and Cherokee Reservoir is releasing flow, the water is relatively hard. Tributaries above the Alabama State line include the Little Tennessee River, Clinch River, and Hiwassee River (Tennessee Valley Authority, 1948, p. 11).

At Hales Bar near Chattanooga, upstream from the Alabama State line, the average discharge for 29 years is 34,370 cfs. At Florence, Ala., furthestmost downstream gaging station on the river in this State, the average discharge for 65 years of record is 50,640 cfs. This shows an average gain of over 16,000 cfs in water entering the river, mostly from Alabama.

Twelve chemical analyses of water from the Tennessee River at Chattanooga, Tenn., and 12 chemical analyses of water from the Tennessee River at Florence, Ala., during 1946 and 1947 (Tennessee Valley Authority, 1948, p. 34 and 39) showed the average mineral content to be 91 ppm at Chattanooga, Tenn., and 82 ppm at Florence, Ala. Therefore, the net effect of water entering the Tennessee River in Alabama is to dilute the waters already in the river. The average mineral content of the water entering the Tennessee River in Alabama is about 63 ppm. Hence it seems that the mineral content of the waters of the Tennessee River is not substantially altered by the water entering the river in Alabama.

Chemical characteristics of the water as determined by analyses of samples taken during this study indicate that at any given time the mineral content of water in the Tennessee River is virtually the same at various points in Alabama (fig. 16).

During the April survey, samples were collected near Fabius and Scottsboro and at Florence and Waterloo. Mineral content ranged from 86 ppm near Fabius to 73 ppm at Waterloo. Specific conductance ranged from 158 micromhos near Fabius to 134 micromhos at Florence. Hardness is about 65 ppm.

During the August survey the Tennessee River was sampled at 6 points: Fabius, Scottsboro, Guntersville, Whitesburg, Decatur, and Florence, Ala. Mineral content (from 4 complete analyses) was 100 ppm at Fabius, 100 ppm at Whitesburg, 99 ppm at Decatur, and 96 ppm at Florence. Specific conductance (6 samples) ranged from 165 to 180 micromhos. The water is slightly alkaline and moderately hard (usually about 70 ppm). Most of the mineral content is due to calcium bicarbonate. Color is less than 5 units.

The analyses of the water of the tributaries to the Tennessee River show variations in chemical character. Kirby Creek near Section, South

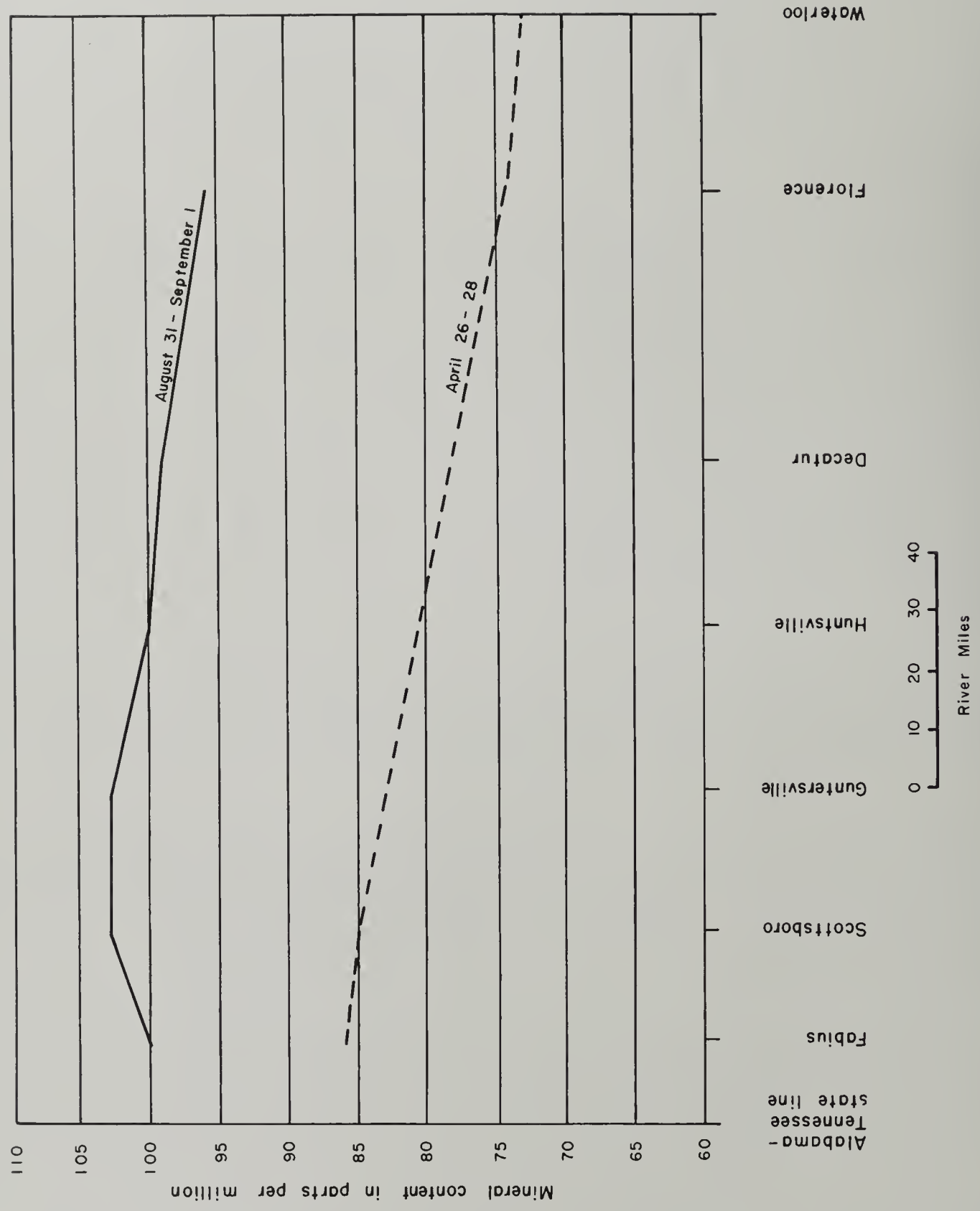


Figure 16. --Mineral content of water of Tennessee River during stream surveys on April 26-28 and August 31-September 1, 1960.

Sauty Creek near Rainsville, Town Creek near Geraldine, Short Creek near Albertsville, and Scarham Creek near Crossville were soft and low in mineral content. Mineral content ranged from approximately 22 ppm to 32 ppm. Hardness in the streams ranged from 8 to 15 ppm, and there was almost no color (less than 10 units).

Paint Rock River near Woodville is one of the most mineralized tributaries to the Tennessee River. Mineral content ranged from 125 to 156 ppm for the 2 samples analyzed. The water in this stream is hard (118 to 142 ppm) and slightly alkaline (7.1 to 7.4 pH). Most of the mineral content was due to calcium bicarbonate. Color is negligible.

Flint River near Huntsville, Ala., is less mineralized than Paint Rock River and Hurricane Creek. Flint River had a mineral content of about 71 ppm, August 31, 1960. The water was soft and slightly alkaline (pH 7.4). The mineral content of Hurricane Creek was about 172 ppm. The water was hard and the pH was 7.9, August 31, 1960. Color in both these streams was less than 5 units.

Indian Creek had a mineral content of 81 ppm during April-May and August-September surveys. The water at both times was hard and contained almost no color; pH was 7.2 and 7.3.

Cotaco Creek near Somerville had a mineral content of approximately 94 ppm. The water is hard and the color of the stream is low.

Limestone Creek near Athens, and Piney Creek are lower in mineral content than the streams farther east. These streams have a mineral content of about 40 ppm. Almost no color is in either of these streams.

Flint and Fox Creeks are relatively high in mineral content. West Fork Flint Creek had a mineral content of approximately 188 ppm, September 1, 1960; hardness was 165 ppm. Water of Fox Creek and lower Flint Creek is less mineralized and moderately hard.

Swan Creek at old U.S. Highway 31 crossing had a mineral content of approximately 64 ppm, September 1, 1960; hardness was 50 ppm. Downstream at U.S. Highway 72 east of Athens mineral content was approximately 124 ppm, August 31, 1960. The water was moderately hard and at U.S. Highway 72 seemed significantly affected by cultural influences.

Elk River and Sulfur, Anderson, and Bluewater Creeks have relatively high mineral content (64 to 112 ppm). Water in these streams ranges from soft to moderately hard.

Cypress Creek is lower in mineral content than Middle Cypress and Little Cypress Creeks. These streams are in the same area, but the geologic map of Alabama indicates that more of the drainage basin of Cypress Creek is in the area of less soluble rocks. Little Cypress and Middle Cypress Creeks had chemical characteristics similar to the water in streams to the east such as Anderson and Bluewater Creeks.

Spring Creek near Muscle Shoals had a mineral content of 120 ppm on April 28, 1960. The water was moderately hard.

Bear Creek is low in mineral content; the water is soft and sometimes siliceous.

Cedar, Lick, and the downstream areas of Little Bear Creeks have relatively high mineral content (99 to 165 ppm), and the waters are moderately hard to hard.

SUMMARY

Mineral content or mineralization is used in this report as an index of chemical quality. In general, lower mineralization indicates better quality. Water containing a mineralization of less than 500 ppm may be considered usable for most purposes, although a particular user may need to remove some of the mineral constituents in the water.

The mineral content of water in streams of Alabama is low. In 90 percent or more of the streams sampled the mineral content is less than 200 ppm. Omitting those observations which were considered to be extremes, the lowest mineral contents occur in waters in the southwestern part of the State; the highest occur in the Tennessee section and the Black Prairie Belt of the East Gulf Coastal Plain section (fig. 1).

Hardness is perhaps the most objectionable feature of water quality. Some waters in the State exceed 120 ppm hardness. The hardest waters occur in the same areas as do those of high mineral content.

Silica is one of the principal mineral constituents in water of most streams in the State, and it is the principal mineral constituent in water draining the Piedmont Upland section.

Higher concentrations of sulfate are present in streams in and around Birmingham than in other areas of the State.

For the most part, the chemical characteristics of water of the State are due to natural conditions. Mineralization is related to rock type and precipitation. Differences in the mineralization between areas

in the State are due chiefly to differences in rock type, whereas differences in mineralization within small areas are related to rainfall.

Color (generally less than 20 units) probably is a result of biologic influences. Color is more prevalent in streams in the southwestern part of the State than in other areas.

With few exceptions surface waters of the State are suitable for municipal, industrial, and agricultural purposes.

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BASIC DATA

Table 10. --Chemical analyses of selected streams

Chemical constituents, in parts per million

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids ^b / _l	Hardness as CaCO ₃		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
1	CHATTAHOOCHEE RIVER BASIN	1960																		
	Hardley Creek near Lanett, Ala.	Aug. 30	.....	...	...	...	...	3.7	1.1	32	a/ 6.3		...	...	53	24	0	59	7.3	3
2	Osilgee Creek near Lanett, Ala.	Apr. 27	.....	...	...	...	...	...	...	28	...	...	...	...	50	19	0	55	7.3	3
		Aug. 30	.....	...	...	...	...	4.4	1.3	38	a/ 3.3	...	...	...	61	24	0	68	7.7	4
3	Chattahoochee River at West Point, Ga.	Apr. 27	.....	9.9	0.14	3.9	1.0	4.2	1.1	22	2.8	2.2	0.7	0.0	c/ 37	14	0	48	7.5	4
		Aug. 30	.....	8.3	.01	3.6	.7	4.2	1.1	19	3.2	3.0	.1	.8	c/ 34	12	0	45	6.6	3
4	Osanippa Creek near Fairfax, Ala.	Apr. 27	.....	...	...	...	...	...	...	11	...	...	...	...	49	22	13	54	7.3	3
		Aug. 30	.....	...	...	...	...	4.3	1.1	38	a/ 4.2	...	...	...	58	25	0	65	7.4	3
5	Halawakee Creek near Opelika, Ala.	Apr. 27	.....	11	.13	3.1	1.1	4.1	1.0	20	.8	2.0	.1	.0	c/ 33	12	0	41	6.9	4
		Aug. 30	.....	13	.00	3.8	1.1	3.5	1.2	24	.0	2.8	.1	.4	c/ 38	14	0	45	6.7	2
6	Wacoochee Creek near Phenix City, Ala.	Apr. 27	.....	...	...	...	...	...	...	22	...	...	...	...	44	12	0	49	7.2	8
7	Soap Creek near Bleaker, Ala.	Apr. 27	.....	...	...	...	...	...	...	26	...	...	...	...	55	14	0	61	7.0	..
8	Chattahoochee River at Columbus, Ga.	Apr. 27	.....	2.5	.09	3.2	1.0	4.2	1.2	20	1.2	2.0	.1	.0	c/ 25	12	0	44	6.8	4
		Aug. 30	.....	8.4	.01	3.2	1.3	4.4	1.5	20	3.6	3.0	.2	.8	c/ 36	14	0	52	6.7	5
9	Mills Creek at Phenix City, Ala.	Aug. 30	.....	...	...	...	...	>10	3.0	58	...	...	...	...	93	35	0	141	7.9	7
10	Cochgalechee Creek at Phenix City, Ala.	Aug. 30	.....	...	...	...	...	9.8	1.4	22	a/ 13	...	...	...	41	10	0	62	7.0	4
11	Little Uchee Creek near Seale, Ala.	Aug. 30	.....	...	...	...	...	3.6	1.5	42	a/ 4.6	...	...	...	51	30	0	78	7.1	3
12	Uchee Creek near Seale, Ala.	Aug. 30	.....	7.1	.07	6.0	1.0	1.9	.7	20	2.8	2.5	.2	.0	c/ 32	19	2	48	6.7	5
13	Weolustee Creek at Pittsview, Ala.	Aug. 30	.....	...	...	...	...	10	.9	36	a/ 11	...	...	...	53	20	0	80	7.0	23
14	Hatcheehubee Creek at Pittsview, Ala.	Aug. 30	e/ 2	...	...	...	...	2.1	.9	40	a/ 7.9	...	...	...	57	37	4	87	7.5	27
15	Cowlike Creek near Eufaula, Ala.	Aug. 30	e/ 26	6.6	.11	15	1.1	2.5	1.2	44	6.4	3.0	.2	.0	c/ 58	42	6	98	7.1	10
16	Chewalla Creek at Eufaula, Ala.	Aug. 30	.....	...	...	...	...	4.2	3.4	66	a/ 11	...	...	...	86	54	0	131	7.2	4
17	Chattahoochee River at Eufaula, Ala.	May 1	.....	7.5	.08	4.6	1.0	4.4	1.1	19	4.0	2.1	.2	.7	c/ 35	16	0	51	6.7	3
		Aug. 30	.....	9.2	.01	4.6	1.1	4.2	1.5	21	4.4	3.0	.3	1.1	c/ 39	16	0	58	6.7	5

18	Barbour Creek near Eufaula, Ala.	May 1 Aug. 30	..... .....	8.4 ...	.04 ...	11 ...	1.0 ...	2.8 2.5	.8 1.0	31 32	7.6 a/11	2.8 ...	.2 ...	.1 ...	c/ 50 50	32 32	6 6	78 76	7.3 6.9	7 3
19	Cheneyhatchee Creek near Eufaula, Ala.	Aug. 30	.....	...	...	...	...	2.0	.9	20	a/ 3.3	...	...	...	27	15	0	41	7.0	3
20	Chattahoochee River near Shorterville, Ala.	Aug. 29	.....	8.9	.04	5.6	1.5	3.9	1.3	26	4.8	3.0	.0	.3	42	20	0	63	6.7	8
21	Abbie Creek near Abbeville, Ala.	Aug. 29	e/ 12	...	...	...	...	5.6	1.0	14	a/15	...	...	...	38	16	5	58	7.1	4
22	Abbie Creek near Haleburg, Ala.	Aug. 29	105	7.8	.03	4.4	.5	2.5	.7	17	.4	3.0	.0	.5	c/ 28	13	0	40	7.1	10
23	Peterman Creek near Shorterville, Ala.	Aug. 29	.....	...	...	...	...	1.8	.8	14	a/ 5.4	...	...	...	22	13	2	33	6.9	5
24	Unnamed creek near Haleburg, Ala.	Aug. 29	.....	...	...	...	...	2.7	.4	14	a/ 4.6	...	...	...	22	10	0	33	6.9	3
25	Chattahoochee River at Columbia, Ala.	May 1 Aug. 29	..... .....	9.1 7.9	.01 .02	5.2 5.6	.9 .9	4.3 3.9	1.1 1.4	22 25	4.0 4.4	2.4 2.8	.1 .1	.6 .8	c/ 39 c/ 40	16 18	0 0	54 59	6.8 7.3	4 7
26	Omussee Creek at Columbia, Ala.	Aug. 29	e/ 170	7.1	.01	7.6	.2	3.8	.6	29	1.6	4.8	.2	.4	c/ 40	20	0	65	6.8	5
27	Cedar Creek near Gordon, Ala.	May 1	.....	...	...	...	...	...	...	55	...	...	...	...	67	46	0	102	7.7	4
28	Chattahoochee River near Alaga, Ala.	Aug. 28	.....	11	.02	6.4	1.0	4.4	1.0	28	4.0	2.2	.2	.4	c/ 45	20	0	63	6.6	5
29	Bryans Creek near Crosby, Ala.	May 1 Aug. 28	..... .....	4.7 ...	.48 ...	13 ...	.0 ...	2.6 1.6	.2 .2	28 96	1.2 a/ 4.6	8.8 ...	.1 ...	.2 ...	c/ 50 106	32 80	0 2	72 161	7.5 7.4	22 8
30	Cowarts Creek near Cottonwood, Ala.	Aug. 28	.....	...	...	...	...	2.8	.5	95	a/ 7.1	...	...	...	110	80	2	166	7.9	8
31	Basemore Lake near Gordcn, Ala.	Aug. 28	.....	...	...	...	...	2.0	.4	96	a/ 5.4	...	...	...	109	80	2	165	7.6	3
32	Big Creek near Cottonwood, Ala.	Aug. 28	.....	7.0	.05	10	.2	1.6	.8	30	2.4	2.0	.1	.2	c/ 39	26	2	62	6.8	5
33	Chattahoochee River near Crosby, Ala.	May 1	.....	...	...	...	...	...	...	28	...	...	...	...	42	20	0	64	7.7	8
CHOCTAWHATCHEE RIVER BASIN																				
1	Beaver Creek near Clio, Ala.	Aug. 30	.....	...	...	...	...	3.9	.5	15	a/ 5.4	...	...	...	26	10	0	39	6.8	8
2	Judy Creek near Ozark, Ala.	Apr. 30 Aug. 30	..... .....	8.0 12	.13 .22	2.6 3.8	.6 .7	2.9 2.8	.8 .9	11 16	.8 .0	2.8 5.0	.1 .1	.5 .0	c/ 24 c/ 33	9 12	0 0	31 37	6.6 6.7	8 5
3	Choctawhatchee River near Newton, Ala.	Aug. 29	324	8.1	.03	9.4	.7	2.4	.7	32	.8	2.5	.0	.3	c/ 41	26	0	63	7.0	10
4	Hurricane Creek at Newton, Ala.	Aug. 29	.....	...	...	...	...	>10	1.6	37	...	...	...	...	64	18	0	87	7.1	8
5	Brooking Mill Creek near Daleville, Ala.	Aug. 29	.....	...	...	...	...	1.6	.4	12	a/ 5.0	...	...	...	21	12	2	29	6.8	25
6	Choctawhatchee River near Clayhatchee, Ala.	Apr. 30	.....	...	...	...	...	...	...	23	...	...	...	...	40	19	0	54	7.5	8
7	Hurricane Creek near Hartford, Ala.	Aug. 28	.....	...	...	...	...	3.0	.4	24	a/ 4.6	...	...	...	34	18	0	46	7.2	3
8	Bear Creek near Ozark, Ala.	Aug. 30	.....	...	...	...	...	9.2	1.0	26	a/ 9.2	...	...	...	42	11	0	64	7.0	8
9	Claybank Creek near Camp Rucker, Ala.	Aug. 29	.....	6.9	.02	3.4	1.1	3.4	.9	18	1.2	3.0	.0	1.2	c/ 30	13	0	44	6.3	3

Table 10.--Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids ^b / _l	Hardness as CaCO ₃		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
CHOCTAWHATCHEE RIVER BASIN --Continued																				
10	Choctawhatchee River near Geneva, Ala.	Aug. 28		7.6	0.02	6.4	1.0	2.5	0.7	24	1.6	3.2	0.1	0.1	c/ 35	20	0	53	6.5	5
11	Double Bridges Creek near Elba, Ala.	Aug. 29		. . .	. . .	. . .	. . .	2.8	.6	13	a/ 5.4	. . .	. . .	. . .	23	10	0	31	7.9	22
12	Double Bridge Creek near Geneva, Ala.	Aug. 28		7.3	.01	5.4	1.1	2.8	.7	23	.8	3.0	.0	.4	c/ 32	18	0	50	6.8	5
13	Double Creek near Josie, Ala.	Aug. 30		. . .	. . .	. . .	. . .	5.3	1.8	32	a/ 8.3	. . .	. . .	. . .	45	22	0	68	7.1	. .
14	Buckhorn Creek near Josie, Ala.	Aug. 30		. . .	. . .	. . .	. . .	>10	1.6	54	. . .	. . .	. . .	. . .	77	14	0	117	7.3	8
15	Pea River near Clio, Ala.	Apr. 30		6.0	.22	6.0	1.0	2.8	.8	22	2.0	2.5	.2	.5	c/ 33	19	1	51	6.7	12
		Aug. 30		9.2	.03	6.0	.6	2.4	1.0	22	2.0	3.5	.2	.0	c/ 36	18	0	47	6.7	4
16	Big Creek near Brundidge, Ala.	Apr. 30		12	.17	8.5	1.0	2.4	.5	30	.4	2.5	.1	.4	c/ 43	25	0	60	7.1	3
		Aug. 30		10	.00	15	.5	2.2	.9	48	.0	4.0	.5	.0	c/ 57	40	0	87	7.3	2
17	Richland Creek near Shiloh, Ala.	Aug. 30		. . .	. . .	. . .	. . .	2.9	1.1	36	a/ 6.3	. . .	. . .	. . .	49	29	0	74	7.1	3
18	Richland Creek near Brundidge, Ala.	Aug. 30		. . .	. . .	. . .	. . .	3.7	.6	82	a/ 6.7	. . .	. . .	. . .	94	66	0	142	7.4	3
19	Pea River near Arifton, Ala.	Aug. 30	92	9.5	.01	9.4	.9	2.4	1.0	31	2.8	3.5	.2	.0	c/ 45	27	2	65	6.9	4
20	Whitewater Creek near Brundidge, Ala.	Aug. 30		. . .	. . .	. . .	. . .	2.0	1.0	42	a/ 3.8	. . .	. . .	. . .	51	33	0	78	7.7	4
21	Pea River at Elba, Ala.	Aug. 29		8.4	.03	8.2	1.0	2.1	1.0	31	1.6	3.0	.1	.0	c/ 40	24	0	61	6.7	8
22	Pea River near Samson, Ala.	Aug. 29	472	8.8	.05	9.2	1.1	2.2	1.0	32	1.6	2.0	.2	.5	c/ 43	28	2	62	6.9	3
23	Pea River near Samson, Ala.	Aug. 29		9.8	.04	11	1.0	2.1	.8	38	.8	1.5	.2	.0	c/ 46	32	0	69	7.0	5
24	Pea River near Geneva, Ala.	Aug. 28		8.3	. . .	11	1.1	1.9	.8	39	1.2	2.8	.2	.4	c/ 47	32	0	71	7.1	4
25	Wright's Creek near Slocomb, Ala.	Aug. 28		. . .	. . .	. . .	. . .	1.9	.4	45	a/ 5.4	. . .	. . .	. . .	55	39	2	83	7.6	8
YELLOW RIVER BASIN																				
1	Lightwood Knot Creek near Opp, Ala.	Apr. 30		5.2	.10	1.2	.7	1.3	.4	8	.8	2.0	.0	.2	c/ 16	6	0	20	6.9	8
		Sept. 30		7.2	. . .	1.0	.9	2.4	.4	7	.0	3.2	.2	.0	c/ 19	6	0	23	6.4	30

2	Five Runs Creek near Andalusia, Ala.	Apr. 30 Aug. 29	..... .....	3.6 6.7	.19 .02	4.3 5.4	.9 .9	2.4 4.9	.8 .5	17 24	.8 .8	3.5 6.2	.1 .0	.4 .0	c/ 25 c/ 37	14 17	0 0	44 58	7.3 6.5	8 8
3	Yellow River near Wing, Ala.	Apr. 30 Aug. 29	742 288	...	...	...	1.2 1.2	...	...	30 40	...	...	...	...	44 c/ 46	25 32	0 0	59 74	7.0 7.1	22 5
4	Blackwater Creek near Bradley, Ala.	Apr. 30 Sept. 30	..... .....	3.8 7.7	.31 ...	.9 .8	.1 .5	1.9 1.7	.1 .1	1 2	.8 3.2	2.5 3.2	.1 .2	.0 .0	c/ 11 c/ 18	2 4	2 2	18 43	...	37 40
CONECUH RIVER BASIN																				
1	Unnamed Creek near Troy, Ala.	Apr. 30	.....	...	...	...	...	...	...	6	...	...	...	...	11	3	0	17	6.7	27
2	Conecuh River near Troy, Ala.	Aug. 30	.....	11	.01	5.6	.9	2.4	.9	19	2.4	4.0	.2	.1	c/ 37	18	2	45	6.6	7
3	Conecuh River near Brantley, Ala.	Apr. 30	480	...	...	...	...	...	...	30	...	...	...	...	42	27	2	64	7.4	27
4	Moody's Mill Creek near Brantley, Ala.	Aug. 29	.....	...	...	...	...	3.0	.6	22	a/ 6.3	...	...	...	34	18	0	46	6.5	3
5	Conecuh River at Brantley, Ala.	Aug. 29	221	7.7	.01	11	.9	2.0	.8	38	2.0	2.0	.1	.3	c/ 46	31	0	73	7.0	8
6	Dry Creek near Brantley, Ala.	Aug. 29	.....	...	...	...	...	2.9	.9	39	a/ 5.4	...	...	...	49	31	0	74	7.5	7
7	Bushy Creek near Brantley, Ala.	Aug. 29	.....	...	...	...	...	5.9	.6	19	a/ 7.9	...	...	...	33	11	0	44	7.1	8
8	Buck Creek near Brantley, Ala.	Aug. 29	.....	...	...	...	...	2.2	.9	12	a/ 6.7	...	...	...	22	12	2	30	6.8	27
9	Wolfpit Creek at Dozier, Ala.	Aug. 29	.....	...	...	...	...	2.1	.8	37	a/ 4.2	...	...	...	51	30	0	69	7.0	3
10	Hornet Creek at Dozier, Ala.	Aug. 29	.....	...	...	...	...	2.9	1.6	42	a/ 9.6	...	...	...	59	37	3	80	7.4	3
11	Unnamed stream at Searight, Ala.	Aug. 29	.....	...	...	...	...	2.0	.4	11	a/ 4.2	...	...	...	19	9	0	26	6.8	..
12	Conecuh River near Andalusia, Ala.	Aug. 29	.....	7.5	.03	7.0	.6	2.0	.8	26	1.6	2.0	.0	.0	c/ 34	20	0	51	7.1	5
13	Olustee Creek at Shady Grove, Ala.	Apr. 30 Sept. 30	..... .....	6.2 7.3	... ...	6.2 4.4	.6 1.0	2.7 1.8	.8 1.0	22 14	2.0 .8	3.0 3.5	.1 .2	.1 .4	c/ 33 c/ 27	18 15	0 4	48 40	7.3 6.4	28 30
14	Patsaliga Creek at Luverne, Ala.	Apr. 30 Aug. 30	..... .....	... 8.4	00	... 11	7	... 2.2	8	31 36	... 2.0	... 3.5	1	0	42 c/ 47	37 30	12 1	63 70	7.3 6.8	8 3
15	Persimmon Creek near Greenville, Ala.	Sept. 1	.....	10	.01	15	.9	4.3	1.0	53	2.0	3.0	.2	.7	c/ 63	41	0	99	6.9	3
16	Stallings Creek near Greenville, Ala.	Sept. 1	.....	...	...	...	...	2.5	1.0	26	a/ 7.9	...	...	...	36	24	2	55	7.3	8
17	Stallings Creek near Greenville, Ala.	Sept. 1	.....	...	...	...	...	1.8	.9	38	a/ 4.2	...	...	...	48	31	0	72	7.2	3
18	Rocky Creek near Georgiana, Ala.	Sept. 1	.....	...	...	...	...	...	...	96	...	...	...	...	158	39	0	214	7.6	42
19	Persimmon Creek near Georgiana, Ala.	Sept. 1	.....	...	...	...	...	6.0	1.1	43	a/ 10	...	.0	.0	59	33	0	90	7.3	4
20	Sepulga River near McKenzie, Ala.	Sept. 1	61	11	.04	6.2	1.1	2.7	1.2	24	.8	4.0	.2	.1	c/ 39	20	0	53	6.8	28
21	Piney Woods Creek near Evergreen, Ala.	Sept. 1	.....	...	...	...	...	2.8	.4	11	a/ 4.6	...	...	...	21	8	0	29	6.9	22
22	Conecuh River near Brooklyn, Ala.	Apr. 30 Sept. 30	..... .....	... 8.6	... ...	... 10	... 1.5	... 2.1	8	33 35	... 1.6	... 2.2	2	1	51 c/ 44	28 31	0 2	69 71	7.5 6.7	8 5

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids $\frac{b}{c}$	Hardness as CaCO ₃		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
23	CONECUH RIVER BASIN--Continued	1960																		
	Murder Creek near Evergreen, Ala.	Sept. 1	136	9.9	0.02	4.8	0.4	1.8	0.4	16	0.8	2.0	0.1	0.6	c/29	14	0	36	6.8	5
24	Burnt Corn Creek at Brewton, Ala.	Apr. 30 2/6/61	.....	...	...	...	...	2.0	.1	29	...	...	...	...	44	25	1	60	7.2	17
			.....	...	...	...	...	...	...	24	a/7.5	...	...	...	40	24	4	54	7.0	22
25	Little Escambia Creek near Repton, Ala.	Sept. 1	.....	...	...	...	...	3.4	.1	8	a/4.2	...	...	...	18	4	0	24	6.6	8
26	Little Escambia Creek near Pollard, Ala.	Apr. 30 2/6/61	.....	...	...	...	...	...	...	2	...	...	...	...	266	40	38	359	5.2	3
			.....	...	...	...	...	>10	1.1	4	...	...	...	...	506	81	78	684	6.0	7
	COOSA RIVER BASIN	1960																		
1	Coosa River near Coosa, Ga.	Apr. 26 Aug. 31	.....	6.5	.09	15	3.0	7.4	1.0	58	14	3.0	.2	.0	c/79	50	2	133	7.3	5
			.....	8.3	.01	12	3.0	8.2	1.0	49	13	5.8	.7	.6	c/77	42	2	119	6.9	4
2	Coosa River at Cedar Bluff, Ala.	Aug. 31	.....	...	...	...	...	>10	1.4	56	...	...	...	...	87	50	4	145	7.3	4
3	Chattooga River near Cedar Bluff, Ala.	Apr. 26 Aug. 31	e/432 e/145	...	...	...	...	...	...	152	...	...	...	...	159	98	0	265	7.9	2
			...	...	...	...	...	>10	.9	159	...	...	...	...	181	125	0	302	7.6	4
4	Little River near Cedar Bluff, Ala.	Aug. 31	2.6	...	...	...	...	1.6	.6	10	a/3.8	...	...	...	14	8	0	23	6.9	3
5	Spring Creek near Cedar Bluff, Ala.	Apr. 26 Aug. 31	2.6	...	...	...	...	...	...	121	...	...	...	...	118	100	1	196	7.9	3
			.....	...	...	...	...	.8	.5	134	a/2.5	...	...	...	124	111	1	206	7.9	4
6	Coosa River near Leesburg, Ala.	Apr. 26 Aug. 31	.....	3.5	.08	16	2.3	6.6	1.0	61	9.2	3.7	.2	.0	c/72	50	0	129	7.3	5
			.....	9.3	.02	15	3.5	8.7	1.0	64	9.6	5.5	.3	.0	c/85	52	0	131	6.8	4
7	Coosa River at Gadsden, Ala.	Aug. 31	2,620	7.0	.02	13	3.3	6.0	.9	56	9.6	4.0	.1	.1	c/72	46	0	115	6.7	7
8	Big Wills Creek near Collinsville, Ala.	Apr. 26 Aug. 31	.....	6.2	.10	41	4.7	1.7	.7	142	4.8	2.5	.1	.6	c/132	122	6	243	7.1	5
			.....	6.9	.01	36	9.8	5.3	.7	158	4.4	6.5	.3	1.3	c/149	130	1	249	7.9	2
9	Big Wills Creek in Gadsden, Ala.	Apr. 26	.....	...	...	...	...	...	...	120	...	...	...	...	122	99	0	203	7.9	2
10	Black Creek near Bellevue, Ala.	Apr. 26	.....	...	...	...	...	...	...	0	...	...	...	...	188	100	100	313	4.6	3

11	Big Wills Creek in Gadsden, Ala.	Apr. 26 Aug. 31	..... .....	4.2 ...	1.1 ...	30 ...	4.6 ...	4.7 5.5	1.8 2.2	85 94	21 a/31	5.2 ...	.3 ...	3.7 ...	c/118 136	94 99	24 22	212 226	7.4 7.7	4 3
12	Coosa River near Southside (near Gadsden), Ala.	Apr. 26 Aug. 31	..... .....	4.3 7.5	.10 .01	8.4 16	6.8 2.8	5.6 6.0	1.0 1.2	58 61	7.6 9.6	3.5 4.5	.1 .2	.3 1.1	c/67 c/79	49 52	2 2	120 127	7.4 6.9	4 4
13	Big Canoe Creek near Springville, Ala.	Aug. 29	.....	7.7	.00	31	6.4	1.6	.9	125	2.8	1.0	2.1	.3	c/116	104	2	199	7.4	2
14	Big Canoe Creek near Ashville, Ala.	Apr. 26 Aug. 31	..... .....	5.2 7.2	.16 .10	30 33	3.4 7.2	2.2 1.4	.6 .8	106 130	4.8 4.0	1.6 2.0	.1 .1	.1 .1	c/100 c/120	89 112	2 6	179 207	7.6 7.3	2 3
15	Big Canoe Creek near Gadsden, Ala.	Apr. 26 Aug. 31	187 28	... 7.8	02	... 34	... 6.7	... 1.8	7	104 135	... 4.0	... 1.8	1	4	104 c/124	88 112	2 2	174 207	7.9 7.3	2 4
16	Beaver Creek near Ashville, Ala.	Aug. 31	.....	...	...	...	...	1.2	1.1	184	a/3.3	...	...	...	173	151	0	289	7.9	3
17	Shoal Creek near Ashville, Ala.	Apr. 26	.....	...	...	...	...	...	...	30	...	...	...	...	38	25	0	63	7.2	4
18	Broken Arrow Creek near Pell City, Ala.	Apr. 26 Aug. 31	..... .....	... ...	... ...	... ...	... ...	... >20	... 1.3	14 52	... ...	... ...	... ...	... ...	23 86	11 36	0 0	39 143	7.2 7.4	7 5
19	Coosa River at Riverside, Ala.	Apr. 26 Aug. 30	..... .....	7.3 6.7	.08 .02	17 19	2.3 2.8	5.6 8.2	.9 1.1	59 73	7.6 12	3.2 6.2	.2 .2	.3 .1	c/73 c/92	52 59	4 0	125 148	7.9 6.9	4 3
20	Choccolocco Creek near Choccolocco, Ala.	Aug. 30	e/ 32	...	...	...	...	1.7	1.3	86	a/4.6	...	...	...	84	71	0	140	7.9	3
21	Snow Creek near Anniston, Ala.	Aug. 30	.....	...	...	...	...	>10	>10	87	...	...	...	...	1,040	524	452	1,730	7.4	3
22	Choccolocco Creek near Oxford, Ala.	Aug. 30	.....	...	...	...	...	>10	10	92	...	...	...	...	463	270	244	771	7.4	3
23	Coldwater Creek near Coldwater, Ala.	Apr. 26 Aug. 30	..... .....	... ...	... ...	... ...	... ...	... 1.9	... 1.3	120 123	... a/7.1	... ...	... ...	... ...	116 118	98 104	0 3	193 197	8.0 8.0	3 3
24	Cheaha Creek near Talladega, Ala.	Aug. 30	.....	...	...	...	...	2.1	.6	142	a/5.8	...	...	...	134	118	2	224	7.9	4
25	Choccolocco Creek near Lincoln, Ala.	Apr. 26 Aug. 31	..... .....	... 7.8	03	... 31	... 16	... 14	... 3.5	102 124	... 8.4	... 48	2	7	124 c/191	90 144	6 42	207 342	7.8 7.4	4 4
26	Kelly Creek at Lowley, Ala.	Apr. 28 Aug. 30	..... .....	8.0 7.5	.24 .03	6.4 8.2	1.0 1.3	1.6 2.6	.7 1.1	25 32	2.0 6.0	1.0 1.8	.0 .1	.4 .6	c/33 c/45	20 26	0 0	52 63	7.9 6.9	2 2
27	Bear Creek near Vincent, Ala.	Apr. 28	.....	...	...	...	...	...	...	15	...	...	...	...	26	12	0	44	6.9	11
28	Wolf Creek near Sterett, Ala.	Apr. 28 Aug. 30	..... .....	6.8 7.6	.42 .04	7.5 11	1.6 1.3	2.3 2.8	1.0 1.2	24 40	8.4 7.2	1.8 2.5	.1 .1	.6 .6	c/42 c/54	25 33	6 0	65 80	6.8 6.8	6 3
29	Talladega Creek at Talladega, Ala.	Aug. 30	.....	...	...	...	...	4.2	.9	81	a/7.9	...	...	...	87	66	0	145	7.7	4
30	Talladega Creek at Childersburg, Ala.	Apr. 28 Aug. 30	..... .....	... ...	... ...	... ...	... ...	... 3.6	... 1.1	102 142	... a/10	... ...	... ...	... ...	102 137	85 119	0 2	170 228	8.0 7.8	4 2
31	Tallasseehatchee Creek near Childersburg, Ala.	Aug. 30	.....	...	...	...	...	>10	2.8	156	...	...	...	...	227	125	0	378	7.9	4
32	Tallasseehatchee Creek at Childersburg, Ala.	Apr. 28 Aug. 30	..... .....	... ...	... ...	... ...	... ...	... >10	... 2.5	118 157	... ...	... ...	... ...	... ...	132 211	95 127	0 0	220 352	7.7 7.9	4 3

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved solids ^b / _l	Hardness as CaCO3		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
33	COOSA RIVER BASIN -- Continued Coosa River at Childersburg, Ala.	1960 Apr. 28	11, 100 4, 530	6.3 8.9	0.07 .05	16 20	3.6 5.6	4.6 14	1.0 1.4	64 84	8.4 18	3.8 13	0.1 .1	0.5 .5	c/76 c/122	55 73	2 4	135 202	8.1 7.3	3 8
		Aug. 30																		
34	Walnut Creek at Clanton, Ala.	Aug. 31	.....	...	...	...	...	9.0	1.2	44	a/25	...	...	...	82	44	8	137	7.2	3
35	Hatchet Creek near Goodwater, Ala.	Apr. 28	.....	9.4	.09	3.0	.9	1.3	.8	15	2.8	1.2	.1	.1	c/27	11	0	32	7.5	4
		Aug. 29	.....	8.1	.04	4.8	1.1	2.1	.6	23	2.4	2.0	.1	.0	c/32	16	0	41	6.9	2
36	Topuske Creek near Goodwater, Ala.	Apr. 28	.....	9.5	.14	3.0	.5	2.2	.6	10	3.2	1.2	.1	.0	c/25	10	2	28	7.0	5
		Aug. 29	.....	14	.08	3.4	1.3	2.3	.6	16	5.6	4.0	.1	.5	c/40	14	1	38	6.6	2
37	Hatchet Creek near Rockford, Ala.	Apr. 28	309	11	.06	3.0	.6	3.2	.6	14	6.8	1.3	.1	.0	c/34	10	0	32	7.4	7
		Aug. 29	47	12	.02	3.6	1.0	3.2	.9	22	2.4	1.8	.1	.2	c/36	13	0	39	6.8	3
38	Swamp Creek at Salter, Ala.	Apr. 28	.....	...	...	...	...	...	...	18	...	...	...	...	37	10	0	42	7.2	8
		Aug. 29	.....	...	...	...	...	4.5	1.1	22	a/2.9	...	...	...	37	10	0	41	7.0	7
39	Coosa River at Mitchell Dam, Ala.	Apr. 28	.....	...	...	...	...	...	...	58	...	...	...	...	74	50	2	123	7.5	4
		Aug. 29	.....	...	...	...	...	>10	1.7	72	...	...	...	...	106	70	11	176	7.5	3
40	Chestnut Creek at Verbena, Ala.	Apr. 28	.....	...	...	...	...	...	...	12	...	...	...	...	33	10	0	37	7.0	18
		Aug. 31	.....	6.9	.04	3.0	1.3	2.1	1.0	15	1.2	2.8	.2	.2	c/26	13	0	37	7.1	5
41	Sandy Creek at Verbena, Ala.	Aug. 31	.....	...	...	...	...	1.5	.8	10	a/3.8	...	...	...	22	8	0	24	6.7	17
		Apr. 27	14, 300	5.8	.16	11	3.6	4.4	1.0	47	6.8	2.8	.1	.2	c/59	42	4	100	7.6	4
42	Coosa River at Wetumpka, Ala.	Aug. 29	5, 460	4.7	.01	17	5.5	11	1.3	76	12	13	.1	.6	c/102	65	2	162	7.2	3
		Apr. 28	.....	...	...	...	...	...	...	6	...	...	...	...	18	5	0	20	6.7	8
43	Mortar Creek at Myrick Chapel, Ala.	Aug. 31	.....	...	...	...	...	1.0	.5	12	a/.4	...	...	...	21	8	0	23	7.0	3
		1960	.....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1	Cahulga Creek near Heflin, Ala.	Aug. 30	.....	12	.02	4.0	1.0	3.2	.6	24	1.2	2.0	.3	.4	c/37	14	0	39	6.8	3
2	Cahulga Creek near Heflin, Ala.	Apr. 26	.....	9.0	.14	4.6	1.1	7.4	.5	20	.8	11	.2	.0	c/44	16	0	66	6.8	4
		Aug. 30	.....	...	...	...	...	7.7	1.1	28	a/10	...	...	...	66	17	0	73	7.1	7
3	Tallapoosa River near Belltown, Ala.	Apr. 26	.....	8.2	.07	3.2	.5	3.0	.6	14	1.6	1.4	.1	.0	c/26	10	0	31	6.8	3
		Aug. 30	.....	11	.06	3.0	1.0	3.0	.6	20	.4	2.8	.1	.2	c/32	12	0	36	6.9	3

4	Mad Indian Creek near Dingley, Ala.	Apr. 26 Aug. 30		8.9 9.3	.11 .02	1.1 1.8	.6 .4	1.8 2.0	.8 .9	8 11	.4 .8	1.0 2.8	.2 .0	.0 .5	c/ 19 c/ 24	5 6	0 0	21 23	6.7 6.2	4 2
5	Little Tallapoosa River near Wedowee, Ala.	Apr. 26 Aug. 30		6.1 10	.11 .03	2.8 3.0	.5 .9	3.1 4.4	.7 .8	12 18	1.2 3.2	1.8 3.5	.1 .2	.0 .2	c/ 22 c/ 35	9 11	0 0	33 43	6.8 6.6	4 3
6	Piney Wood Creek near Cedron, Ala.	Apr. 26		. . .	. . .	. . .	. . .	. . .	. . .	8	. . .	. . .	. . .	. . .	21	5	0	23	6.7	5
7	Piney Wood Creek near Milner, Ala.	Aug. 30		. . .	. . .	. . .	. . .	1.6	.7	10	a/ 2.9	. . .	. . .	. . .	17	7	0	19	6.8	7
8	Wedowee Creek near Wedowee, Ala.	Apr. 26 Aug. 30		. . .	. . .	. . .	. . .	. . .	. . .	7 12	. . . a/ 4.6	. . . 4.6			20 22	5 10	0 0	22 25	6.6 7.0	4 3
9	Tallapoosa River near Wedowee, Ala.	Aug. 30		. . .	. . .	. . .	. . .	3.2	.9	18	a/ 5.0	. . .	. . .	. . .	33	13	0	37	6.9	5
10	Fox Creek near Lineville, Ala.	Apr. 26 Aug. 30		. . .	. . .	. . .	. . .	. . .	. . .	8 12	. . . a/ 3.3	. . . 3.3			22 22	6 8	0 0	24 25	6.7 7.0	4 3
11	Crooked Creek near Lineville, Ala.	Apr. 26		7.0	.21	2.3	.4	2.4	.7	9	1.6	1.2	.1	.5	c/ 21	7	0	25	6.3	4
12	Crooked Creek at Cragford, Ala.	Aug. 30		8.6	.02	2.2	.5	2.8	1.0	13	1.6	3.5	.1	1.0	c/ 28	8	0	30	6.4	2
13	Wesobulga Creek near Cragford, Ala.	Aug. 30		. . .	. . .	. . .	. . .	2.6	.9	14	a/ 2.5	. . .	. . .	. . .	24	8	0	27	7.0	4
14	Cedar Creek near Wadley, Ala.	Apr. 26		. . .	. . .	. . .	. . .	. . .	. . .	10	. . .	. . .	. . .	. . .	23	5	3	26	7.0	3
15	Tallapoosa River at Wadley, Ala.	Apr. 26 Aug. 30	2,260 404	8.6 9.3	.08 .02	2.7 2.6	.5 .7	3.1 3.1	.6 1.0	11 16	2.4 2.0	1.6 2.0	.1 .1	.0 .7	c/ 25 c/ 29	8 10	0 0	29 35	6.4 6.2	7 3
16	High Pine Creek at Abanda, Ala.	Aug. 30		. . .	. . .	. . .	. . .	4.0	1.6	27	a/ 5.4	. . .	. . .	. . .	50	18	0	55	7.1	4
17	Town Creek near Alexander City, Ala.	Apr. 28 Aug. 29		19 23	.15 .03	3.5 3.4	.6 .6	3.9 5.4	1.2 1.8	22 27	.4 1.2	1.5 3.0	.1 .1	.2 .1	c/ 41 c/ 52	11 11	0 0	43 46	7.6 6.6	5 3
18	Emuckfaw Creek near Alexander City, Ala.	Apr. 28 Aug. 29		. . .	. . .	. . .	. . .	. . .	. . .	30 34	. . . a/ 7.9	. . . 7.9			53 76	16 18	0 0	59 84	7.3 7.0	4 3
19	Tallapoosa River near Alexander City, Ala.	Aug. 29		. . .	. . .	. . .	. . .	3.3	1.1	18	a/ 3.8	. . .	. . .	. . .	33	11	0	37	7.2	4
20	Sandy Creek near Dadeville, Ala.	Apr. 27 Aug. 29		13 15	.17 .02	3.1 3.4	1.5 1.6	2.4 3.9	.9 .9	22 26	.8 1.2	1.6 3.0	.0 .1	.5 .1	c/ 35 c/ 42	14 15	0 0	43 46	7.3 6.7	2 3
21	Buck Creek near Dadeville, Ala.	Aug. 29		. . .	. . .	. . .	. . .	2.2	1.4	23	a/ 3.3	. . .	. . .	. . .	41	16	0	45	6.9	4
22	Soughatchee Creek near Reeltown, Ala.	Apr. 27 Aug. 29		. . .	. . .	. . .	. . .	. . .	. . .	38 122					76 222	19 21	0 0	84 246	7.4 7.6	3 4
23	Tallapoosa River at Tallassee, Ala.	Apr. 27 Aug. 29		8.7 9.1	.17 .03	2.8 2.6	1.0 1.0	4.1 5.0	.9 .8	14 20	2.8 2.4	2.0 2.5	.1 .0	.0 .4	c/ 29 c/ 34	11 10	0 0	36 40	7.0 6.4	7 3
24	Uphapee Creek near Tuskegee, Ala.	Aug. 30		6.1	.06	6.8	3.4	4.4	2.0	38	3.2	4.0	.3	.1	c/ 49	31	0	84	6.8	5
25	Uphapee Creek near Tuskegee, Ala.	Apr. 27 Aug. 30		7.0 4.7	.19 .02	4.8 7.2	.9 2.8	3.6 4.6	1.1 1.8	20 39	2.8 4.8	2.5 4.5	.1 .1	.0 .4	c/ 33 c/ 50	16 30	0 0	48 78	6.7 6.9	4 3
26	Chinquapin Creek near Tuskegee, Ala.	Apr. 27 Aug. 29		. . .	. . .	. . .	. . .	. . .	. . .	14 14	. . . a/ 7.9	. . . 7.9			34 32	6 10	0 0	38 36	7.4 7.1	4 12

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids lb/	Hardness as CaCO ₃		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
27	TALLAPOOSA RIVER BASIN--Continued Calabee Creek near Tuskegee, Ala.	1960																		
		Apr. 27	.....	4.4	0.20	10	0.4	4.2	1.2	29	6.4	4.8	0.2	0.3	c/46	26	2	76	6.9	12
		Aug. 29	.....	7.5	.25	11	.4	3.2	2.2	32	4.8	6.0	.2	.4	c/52	29	3	73	6.7	18
28	Gubahatchee Creek near Shorter, Ala.	Aug. 29	.....	...	...	...	...	2.3	1.7	26	a/8.8	...	...	...	53	25	4	59	7.0	27
29	Line Creek near Shorter, Ala.	Aug. 29	.....	...	...	...	...	3.8	2.3	66	a/15	...	...	...	120	60	6	133	7.5	17
ALABAMA RIVER BASIN																				
1	Alabama River near Montgomery, Ala.	Apr. 28 Aug. 31	22,000 9,300	6.3 7.0	2.0 .14	9.6 6.6	2.3 2.6	4.5 5.8	.8 1.2	38 34	5.6 7.4	2.8 3.8	.1 .2	.2 .0	c/51 c/52	34 27	2 0	84 83	7.0 7.2	4 5
2	Pine Creek near Montgomery, Ala.	Aug. 31	.....	...	...	...	...	2.7	.9	16	a/2.5	...	...	...	29	9	0	32	7.0	3
3	Catoma Creek near Montgomery, Ala.	Apr. 28	.....	...	...	...	...	...	...	100	...	...	...	...	123	88	6	220	7.0	18
4	Pintlalla Creek near Montgomery, Ala.	Apr. 28	.....	...	...	...	...	...	...	136	...	...	...	...	144	122	11	257	8.0	12
5	Big Swamp Creek near Lowndesboro, Ala.	Apr. 29 Aug. 31	16 17	3.3 10	.11 .03	81 59	1.1 .5	8.5 4.4	.7 2.8	222 168	29 4.8	9.6 7.0	.3 .3	.1 .0	c/243 c/172	206 149	24 18	423 294	7.8 7.9	8 21
6	Mulberry Creek near Selma, Ala.	Sept. 1	.....	11	.02	2.2	1.2	1.3	1.7	10	3.2	2.0	.2	.1	c/28	10	2	31	7.0	3
7	Soapstone Creek near Selma, Ala.	Aug. 31	.....	...	...	...	...	5.6	.6	50	a/10	...	...	...	60	40	0	108	7.1	4
8	Alabama River at Selma, Ala.	Apr. 29 Aug. 31	23,400 7,800	6.5 5.8	01	9.7 15	1.6 4.5	4.5 8.9	.8 1.3	35 61	4.8 13	3.2 7.5	.2 .2	.1 .3	c/48 c/86	30 56	2 6	78 148	7.5 7.3	4 3
9	Valley Creek at Selma, Ala.	Aug. 31	.....	...	...	...	...	1.9	1.6	28	a/5.8	...	...	...	54	24	1	60	7.4	2
10	Cahaba River at Trussville, Ala.	Aug. 29	.....	7.2	.01	41	2.3	2.0	1.3	123	8.8	3.0	.2	1.1	c/128	112	11	225	7.5	5
11	Cahaba River near Trussville, Ala.	Apr. 28	.....	...	...	...	...	...	...	80	...	...	...	...	89	68	2	148	7.5	3
12	Cahaba River near Lovick, Ala.	Apr. 28 Aug. 31	..... .....	5.4 11	.27 .03	22 20	6.3 9.2	25 29	1.3 21	63 76	70 79	2.1 2.5	.1 .2	.2 1.0	c/163 c/191	81 88	30 26	272 310	7.3 7.3	3 5
13	Cahaba River at Grant's Mill Bridge near Birmingham, Ala.	Apr. 28	.....	...	...	...	...	...	...	57	...	...	...	...	151	74	28	252	7.4	4

14	Little Cahaba River near Leeds, Ala.	Aug. 31	.....	7.9	.14	51	6.1	12	2.3	176	7.6	14	.2	4.4	c/192	152	8	340	7.2	5
15	Little Cahaba River at Leeds, Ala.	Aug. 31	.....	...	...	...	...	3.8	.6	154	a/8.8	...	...	...	150	127	1	250	8.0	3
16	Little Cahaba River at Leeds, Ala. (tributary of)	Apr. 28	.....	...	...	...	...	...	...	110	...	...	...	...	110	92	2	184	7.9	3
17	Cahaba River near Homewood, Ala.	Apr. 28 Aug. 31	..... .....	1.7 7.4	.17 .02	32 30	3.9 7.1	6.4 7.6	1.4 1.7	104 114	22 18	2.1 3.0	.1 .3	.6 1.2	c/121 c/132	96 104	11 10	222 230	7.7 7.4	3 3
18	Cahaba River near Acton, Ala.	Apr. 29 Aug. 31	..... .....	... 5.4	.02	26	7.5	... 27	... 2.5	84 96	... 60	... 3.5	3	5	136 c/180	85 96	16 18	226 296	7.7 7.5	4 5
19	Mahan Creek near Montevallo, Ala.	Apr. 29	.....	...	...	...	...	...	...	112	...	...	...	...	112	95	3	187	7.8	4
20	Six Mile Creek near Montevallo, Ala.	Apr. 29	e/ 39	...	...	...	...	...	...	52	...	...	...	...	58	42	0	96	7.6	7
21	Schultz Creek near Centreville, Ala.	Aug. 31	.....	7.2	.01	29	7.2	.7	.8	123	11	1.5	.2	.3	c/119	102	1	193	8.1	1
22	Cahaba River at Centreville, Ala.	Apr. 29 Aug. 31	634 222	2.4 8.8	.09 .02	25 28	6.0 7.8	6.6 4.3	1.0 1.7	102 117	18 11	1.8 2.0	.2 .2	.0 .1	c/111 c/122	87 102	4 10	203 208	7.9 7.9	4 2
23	Haysop Creek at Brent, Ala.	Aug. 31	.....	...	...	...	...	2.8	1.4	48	a/7.9	...	...	...	53	41	2	89	7.1	4
24	Affonee Creek near Harrisburg, Ala.	Aug. 31	.....	...	...	...	...	1.0	.6	10	a/3.3	...	...	...	22	9	1	24	7.0	22
25	Blue Outtee Creek near Harrisburg, Ala.	Aug. 31	.....	...	...	...	...	.9	.4	8	a/.8	...	...	...	15	5	0	17	6.7	8
26	Taylor Creek near Harrisburg, Ala.	Aug. 31	.....	...	...	...	...	...	...	8	...	...	...	...	18	6	0	20	6.7	12
27	Wallace Creek at Heiberger, Ala.	Apr. 29 Aug. 31	..... .....	... ...	... ...	... ...	... ...	... 6.9	... 1.5	10 21	... a/10	...	...	...	255 44	8 12	0 0	283 49	6.9 7.1	2 4
28	Old Town Creek near Heiberger, Ala.	Apr. 29 Aug. 31	..... .....	... ...	... ...	... ...	... ...	... 1.1	... 1.4	12 16	... a/4.2	...	...	...	33 36	14 13	4 0	37 40	6.7 7.0	3 4
29	Cahaba River at Sprott, Ala.	Apr. 29 Aug. 31	948 371	4.7 9.3	.11 .02	20 23	5.2 6.7	4.6 4.8	1.0 1.5	81 96	12 10	2.4 3.0	.2 .2	.0 .0	c/90 c/106	72 85	5 6	161 178	7.4 7.4	3 2
30	Goose Creek at Sprott, Ala.	Aug. 31	.....	...	...	...	...	1.6	.9	12	a/3.8	...	...	...	28	10	0	31	6.8	3
31	Wells Creek near Sprott, Ala.	Aug. 31	.....	...	...	...	...	...	...	18	...	...	...	...	31	11	0	34	7.3	3
32	Water Creek near Sprott, Ala.	Apr. 29	.....	...	...	...	...	...	...	10	...	...	...	...	32	10	2	35	6.8	2
33	Water Creek at Radford, Ala.	Aug. 31	.....	...	...	...	...	4.5	1.8	16	a/10	...	...	...	49	13	0	54	6.8	4
34	Oakmulgee Creek near Perryville, Ala.	Apr. 29	.....	5.5	.11	2.2	.6	1.9	.6	11	.8	2.0	.0	.5	c/20	8	0	25	6.9	3
35	Oakmulgee Creek near Augustin, Ala.	Apr. 29 Aug. 31	..... .....	... 11	01	... 2.2	9	8	9	8 10	8	... 1.8	1	0	35 c/23	10 9	4 1	39 24	6.6 6.5	7 5
36	Childers Creek near Selma, Ala.	Sept. 1	.....	...	...	...	...	2.9	3.0	44	a/9.6	...	...	...	60	37	1	91	7.2	6
37	Cahaba River near Beloit, Ala.	Apr. 29 Sept. 1	..... .....	... 10	00	... 22	... 5.1	... 4.6	... 1.9	72 86	... 9.6	... 2.5	2	0	88 c/98	65 76	6 6	146 171	7.7 8.0	4 2
38	Boguechitto Creek near Orrville, Ala.	Apr. 29 Sept. 1	..... .....	6.2 8.7	.08 .01	26 33	1.2 1.3	3.6 4.2	1.4 2.7	78 99	8.8 .0	4.8 6.0	.1 .3	.7 .0	c/91 c/105	70 88	6 7	161 185	7.5 7.8	7 10

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved solids b/	Hardness as CaCO3		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
ALABAMA RIVER BASIN --Continued																				
39	Bear Creek near Safford, Ala.	1960 Sept. 1	.....	...	...	...	...	>10	2.7	186	...	...	...	...	197	148	0	352	7.9	8
40	Chilatchee Creek at Alberta, Ala.	Apr. 29 Sept. 1	.....	...	...	...	...	...	...	156 146	...	...	...	...	188 149	156 127	28 8	335 266	8.1 7.7	3 12
41	Sturdivent Creek near Awin, Ala.	Sept. 1	.....	19	0.14	2.4	0.9	1.4	1.5	8	1.6	2.5	0.2	0.1	c/ 34	10	3	30	6.1	25
42	Turkey Creek near Pineapple, Ala.	Sept. 1	.....	...	...	...	...	1.2	1.6	6	a/ 5.8		...	...	21	8	2	23	6.5	90
43	Bear Creek near Pineapple Station, Ala.	Sept. 1	.....	8.0	.10	2.0	.9	1.4	1.6	8	.4	2.8	.3	.2	c/ 22	8	2	26	6.5	40
44	Prairie Creek near Oakhill, Ala.	Sept. 1	.6	13	.01	32	3.4	4.2	1.7	114	4.0	3.0	.2	.6	c/ 118	94	0	199	7.4	5
45	Pine Barren Creek near Camden, Ala.	Sept. 1	.....	7.9	.03	18	1.9	2.5	1.2	60	1.6	2.5	.2	.2	c/ 66	53	4	111	7.4	10
46	Alabama River near Millers Ferry, Ala.	Apr. 29 Sept. 1	.....	5.1 7.0	.02 .02	12 15	1.5 3.8	4.6 7.0	.8 1.4	44 60	6.0 7.6	3.0 6.5	.2 .2	.0 .3	c/ 55 c/ 79	36 53	0 4	94 132	7.2 7.8	4 5
47	James Creek at Arlington, Ala.	Apr. 29	.....	17	.15	7.0	4.3	8.7	1.6	27	22	6.8	.1	.3	c/ 81	35	13	124	7.3	7
48	Alabama River at Claiborne, Ala.	Apr. 29 Sept. 1	25,100 9,310	6.1 6.7	.14 .01	11 17	1.0 2.8	4.4 6.9	.8 1.5	38 63	5.6 10	3.0 6.0	.2 .2	.0 .2	c/ 51 c/ 65	32 54	0 2	84 139	7.1 7.6	5 3
49	Shomo Creek near Mount Pleasant, Ala.	Sept. 1	.....	...	...	...	...	1.7	.1	6	a/ 2.9		...	...	13	5	0	17	6.5	8
50	Butterfork Creek at Uriah, Ala.	Sept. 1	.....	...	...	...	...	1.8	.6	7	a/ 5.0		...	...	13	6	0	18	6.7	30
51	Little River near Little River, Ala.	Sept. 1	.....	7.0	.04	.6	.7	1.6	.4	4	.4	2.0	.2	.3	c/ 15	4	1	17	6.3	5
52	Turkey Creek near Blacksher, Ala.	Sept. 1	.....	...	...	...	...	1.8	.9	0	a/ 8.3		...	...	33	5	5	45	4.5	4
53	Holley Creek near Chrysler, Ala.	Sept. 1	.....	...	...	...	...	1.4	.5	3	a/ 4.6		...	...	12	4	2	16	5.5	22
TOMBIGBEE RIVER BASIN																				
1	Bull Mountain Creek near Shottsville, Ala.	1960 Aug. 30	.....	...	...	...	...	1.2	.6	8	a/ 1.7		...	...	14	5	0	16	6.7	3
2	Buttahatchee River below Hamilton, Ala.	Aug. 30	88	7.5	.02	3.0	1.1	.9	.8	12	1.2	2.8	.0	.0	c/ 23	12	2	24	6.7	4
3	Beaver Creek near Guin, Ala.	Aug. 30	.....	...	...	...	...	1.0	1.2	7	a/ 3.3		...	...	16	6	0	18	6.5	12

4	Coalfire Creek near Coal Fire, Ala.	Apr. 30 Aug. 31		7.8 10	.13 .02	2.2 2.0	.5 .7	1.0 1.1	.8 .5	8 10	.0 .1	.3 .0	c/ 18 c/ 24	8 8	1 0	25 23	7.3 6.3	7 14
5	Lubbub Creek near Reform, Ala.	Apr. 30 Aug. 31		6.8 ...	.17 ...	2.8 ...	.9 ...	1.4 1.5	1.0 .9	13 13	.0 ...	.6 ...	c/ 24 28	10 11	0 0	31 31	6.6 6.9	8 36
6	Lubbub Creek near Aliceville, Ala.	Aug. 31	e/ 70	...	...	...	...	2.5	1.6	13	...	...	33	15	4	37	6.7	27
7	Sipsey River near Jones Mill, Ala.	Apr. 29		7.5	.12	3.1	1.3	1.3	.8	11	.1	.1	c/ 29	13	4	42	7.0	3
8	Sipsey River near Fayette, Ala.	Aug. 30	. . . . .	...	...	...	...	2.1	1.2	14	...	...	61	23	12	68	7.1	3
9	Sipsey River near Elrod, Ala.	Apr. 30 Aug. 31	 589 118	... 9.1	02	... 5.2	7	... 1.5	... 1.6	9 14	1	0	32 c/ 34	11 16	4 4	36 39	6.9 6.3	12 4
10	Sipsey River near Pleasant Ridge, Ala.	Apr. 30 Aug. 31	. . . . . . . . . .	... ...	... ...	... ...	... ...	... 1.6	... 1.6	14 12	... ...	... ...	38 32	13 11	2 2	42 35	6.7 6.8	8 11
11	Tombigbee River at Gainesville, Ala.	Apr. 30 Aug. 31	 5,850	8.7 7.9	.25 .03	14 12	1.0 1.1	2.7 3.0	1.4 1.2	44 35	.1 .1	.4 .4	c/ 59 c/ 52	39 34	3 6	96 74	7.2 6.8	4 6
12	Tubb Creek near Mount Hebron, Ala.	Aug. 31	. . . . .	...	...	...	...	6.7	.9	94	...	...	104	81	4	186	7.8	4
13	Trussells Creek at Clinton, Ala.	Apr. 30 Aug. 31		14 ...	.03 ...	3.5 ...	1.3 ...	2.1 3.5	.9 2.5	20 30	.1 ...	.1 ...	c/ 37 59	14 26	0 2	43 65	6.9 6.9	6 7
14	Brush Creek near Clinton, Ala.	Apr. 30	. . . . .	...	...	...	...	...	...	20	...	...	45	16	0	50	7.0	3
15	Tombigbee River at Epes, Ala.	Sept. 1		7.2	.02	11	.7	3.6	1.6	36	.1	.2	c/ 51	30	1	82	6.9	8
16	Tombigbee River near Coatopa, Ala.	Aug. 31	2,480	6.4	.02	17	2.6	12	1.4	55	.1	.0	c/ 92	53	8	156	7.2	4
17	Sucarnoochee River at Livingston, Ala.	Apr. 30 Aug. 31	 143	12 12	.00 .32	6.8 9.2	1.3 .7	3.4 3.1	1.5 1.2	30 26	.1 .0	.6 .0	c/ 51 c/ 49	22 26	0 4	71 60	7.5 6.7	15 4
18	Coatopa Creek at Coatopa, Ala.	Apr. 30	. . . . .	...	...	...	...	...	...	111	...	...	109	94	3	195	7.5	4
19	Sucarnoochee River near Bellamy, Ala.	Aug. 31		6.0	.04	11	1.1	3.2	1.5	34	.1	.0	c/ 54	32	4	79	6.6	18
20	Double Creek near Jefferson, Ala.	Aug. 31	. . . . .	...	...	...	...	5.8	1.9	48	...	...	69	47	8	123	6.9	13
21	Tributary to Allen Creek near Jefferson, Ala.	Apr. 30	. . . . .	...	...	...	...	...	...	80	...	...	94	70	4	168	7.3	14
22	Chickasaw Bogue near Linden, Ala.	Apr. 30		8.7	.02	52	.7	3.9	.9	148	.2	.1	c/ 156	132	11	272	7.7	3
23	Chickasaw Bogue near Linden, Ala.	Aug. 31	. . . . .	...	...	...	...	6.3	3.3	136	...	...	146	120	8	260	7.9	3
24	Chickasaw Bogue near Linden, Ala.	Aug. 31	. . . . .	...	...	...	...	4.4	1.1	209	...	...	194	180	8	346	8.1	..
25	Kinterbish Creek near Ward, Ala.	Sept. 1	. . . . .	...	...	...	...	2.9	1.5	19	...	...	28	14	0	42	7.5	27
26	Tuckabum Creek near Butler, Ala.	May 1 Sept. 1	 41 9.2	20 ...	.03 ...	6.5 ...	2.2 ...	5.6 8.7	1.5 2.0	34 38	.1 ...	.3 ...	c/ 64 59	25 24	0 0	86 90	7.9 6.9	12 18
27	Yantley Creek near Jachin, Ala.	May 1 Sept. 1		21 ...	.02 ...	6.5 ...	1.8 ...	12 >10	1.5 1.8	45 63	.1 ...	.3 ...	c/ 77 85	24 24	0 0	102 129	8.0 7.4	10 8
28	Tombigbee River near Butler, Ala.	May 1 Sept. 1		6.4 5.8	.01 .02	16 17	1.0 1.1	6.3 13	1.4 1.7	44 56	.2 .1	.7 .6	c/ 74 c/ 95	44 47	8 1	131 173	7.6 7.3	8 10

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved solids b/	Hardness as CaCO3		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
TOMBIGBEE RIVER BASIN --Continued																				
29	Horse Creek near Sweetwater, Ala.	1960 May 1 Sept. 1	21 8.6 15		0.04 .02	5.0 6.4	1.7 2.8	3.9 5.0	1.1 1.5	21 32	6.8 7.2	4.5 4.8	0.1 .0	0.4 .6	c/46 c/59	20 28	2 2	65 83	6.5 6.9	12 8
30	Sweetwater Creek at Sweetwater, Ala.	Sept. 1	.....	...	...	...	...	3.4	1.2	31	a/9.6	...	...	...	44	28	2	66	7.3	13
31	Vaughn Creek near Mount Sterling, Ala.	Sept. 1	.....	...	...	...	...	5.8	2.5	40	a/13	...	...	...	62	33	0	94	7.4	3
32	Wahalak Creek at Butler, Ala.	Sept. 1	.....	...	...	...	...	6.9	2.2	45	a/13	...	...	...	70	34	0	106	7.6	3
33	Okatuppa Creek near Gilbertown, Ala.	May 1 Sept. 1	97 23	19 ...	.01 ...	26 ...	1.7 ...	24 >10	1.4 3.3	70 64	10 ...	40 ...	.1 ...	.3 ...	c/156 c/684	72 130	14 78	267 1,140	8.2 7.3	7 8
34	Bogueloosa Creek at Toxey, Ala.	Sept. 1	.....	...	...	...	...	3.0	1.4	14	a/13	...	...	...	35	18	6	53	7.0	23
35	Souwilpa Creek at Souwilpa, Ala.	Sept. 1	.....	...	...	...	...	5.4	1.6	67	a/7.1	...	...	...	72	50	0	120	7.5	80
36	Little Souwilpa Creek at Bolinger, Ala.	Sept. 1	.....	...	...	...	...	3.7	2.0	112	a/14	...	...	...	122	98	6	203	8.1	8
37	Turkey Creek near Silas, Ala.	Sept. 1	.....	...	...	...	...	3.3	1.4	91	a/15	...	...	...	106	83	8	176	7.9	9
38	Taylor Creek at Loper, Ala.	Sept. 1	.....	...	...	...	...	1.2	.2	2	a/4.6	...	...	...	15	4	2	20	5.1	32
39	Dunbar Creek near Millry, Ala.	Sept. 1	.....	...	...	...	...	2.6	1.3	130	a/10	...	...	...	163	140	5	271	..	..
40	Mill Creek at Millry, Ala.	Sept. 1	.....	...	...	...	...	2.0	.4	32	a/14	...	...	...	41	38	12	68	7.2	8
41	Satilpa Creek near Coffeeville, Ala.	May 1	.....	15	.01	22	.4	1.9	.8	67	4.0	2.1	.1	.3	c/80	62	2	122	7.8	7
42	Jackson Creek near Satilpa, Ala.	May 1 Sept. 1	..... .....	..... .....	..... .....	..... .....	..... .....	..... 2.4	6	72 62	 a/5.0	 5.0	..... ...	..... ...	77 67	60 51	1 0	128 111	7.5 7.9	8 3
43	Stave Creek near Jackson, Ala.	Sept. 1	.....	...	...	...	...	2.0	.4	100	a/7.5	...	...	...	103	86	4	171	8.1	2
44	Tombigbee River near Leroy, Ala.	May 1 Sept. 1	13,700 2,920	8.0 6.2	.01 .03	14 17	1.5 1.8	6.7 11	1.1 1.8	44 56	12 13	7.8 13	.2 .1	.2 .0	c/74 c/92	41 50	5 4	125 158	7.3 7.1	3 10
45	E. Bassett Creek near Whatley, Ala.	Apr. 29	.....	...	...	...	...	...	...	60	...	...	...	...	73	48	0	111	7.5	4
46	Little Bassett Creek at Chatom, Ala.	Sept. 1	.....	...	...	...	...	1.6	.3	4	a/4.2	...	...	...	16	4	1	21	5.6	20
47	West Bassett Creek at Bassets Creek, Ala.	Sept. 1	.....	9.9	.12	.8	.4	1.9	.2	2	.4	3.0	.0	.0	c/18	4	2	19	5.4	20

48	Armstrong Creek at Wagerville, Ala.	Sept. 2	.....	...	...	1.4	.1	2	a/ 4.6	...	...	14	4	2	19	5.2	8
49	Lewis Creek near McIntosh, Ala.	Sept. 2	.....	...	...	2.3	.3	5	a/ 5.4	...	...	15	5	1	20	6.6	32
50	Bilbo Creek near McIntosh, Ala.	Sept. 2	.....	...	...	5.1	.2	6	a/13	...	...	31	9	4	42	6.5	23
51	Bates Creek near Calvert, Ala.	Sept. 2	.....	...	...	2.0	.2	6	a/ 4.2	...	...	15	5	0	20	6.7	37
52	Poll Bayou Creek at Calvert, Ala.	Sept. 2	.....	...	...	1.3	.4	4	a/ 5.0	...	...	16	6	2	21	5.9	65
	BLACK WARRIOR RIVER BASIN	1960															
1	Calvert Prong near Oneonta, Ala.	Aug. 29	e/ 11	...	...	3.1	1.5	71	a/70	...	...	191	133	75	281	7.4	3
2	Locust Fork at Powhatan, Ala.	Apr. 29	.....	7.5	.10	14	2.4	40	50	4.5	.2	1.3	c/124	37	217	6.7	2
3	Mulberry Fork near Holly Pond, Ala.	Apr. 28 Aug. 29	..... .....	6.8	.00	...	1.2	14	...	...	...	26	9	0	38	7.0	4
			.....	...	4.2	.5	3.8	18	2.4	4.5	.1	1.3	c/ 34	0	47	6.8	2
4	Duck Creek near Berlin, Ala.	Apr. 28 Aug. 29	..... .....	5.0 4.8	.04 .00	2.2 3.6	1.0 .9	10 18	2.4 2.8	3.0 4.0	.0 .1	1.7 .5	c/23 c/30	0 0	33 47	6.9 6.7	0 2
5	Mulberry Fork near Garden City, Ala.	Aug. 29	67	...	...	3.2	1.8	48	a/10	...	...	69	42	3	101	7.5	3
6	West Fork Sipsey Fork near Double Springs, Ala.	Apr. 28 Aug. 30	..... .....	...	...	...	...	31 19	...	...	...	44 26	26 16	0 1	64 38	7.1 6.9	3 8
7	Clifty Fork near Addison, Ala.	Apr. 28 Aug. 30	..... .....	6.7 4.2	.11 .00	.8 1.0	.7 1.1	10 17	.8 3.2	.8 1.0	.0 .1	.3 .2	c/18 c/24	0 0	24 36	7.1 6.6	3 3
8	Clear Creek near Double Springs, Ala.	Aug. 30	.....	...	...	2.2	1.2	14	a/ 3.3	...	...	21	9	0	31	6.8	8
9	Sipsey Fork near Jasper, Ala.	Aug. 29	102	5.2	.00	1.8	1.5	18	2.8	2.0	.1	.0	c/ 27	0	39	6.8	3
10	Blackwater Creek at Manchester, Ala.	Aug. 30	.....	7.1	.02	2.0	1.3	12	13	1.0	.2	.2	c/ 38	12	58	6.5	5
11	Blackwater Creek near Jasper, Ala.	Apr. 29 Aug. 30	..... .....	7.3 7.5	.07 .01	1.3 2.2	1.0 1.2	10 13	10 15	.8 1.5	.1 .2	.2 .0	c/30 c/41	7 10	45 59	6.8 6.6	2 2
12	Lost Creek near Oakman, Ala.	Aug. 30	7.3	...	...	>10	2.7	42	...	...	...	111	42	8	163	7.1	4
13	Wolf Creek near Oakman, Ala.	Aug. 30	2.8	...	...	>10	2.0	37	a/22	...	...	148	57	26	217	7.6	3
14	Mud Creek near Oak Grove, Ala.	Apr. 29 Aug. 29	..... .....	8.2 11	.09 .21	46 62	6.8 9.2	28 1	235 236	12 24	.7 .2	20 38	c/413 c/440	173 168	641 709	7.0 4.6	8 12
15	Big Yellow Creek near Whitson, Ala.	Apr. 26 Aug. 30	..... .....	7.8 6.7	.09 .00	1.3 2.2	.8 1.3	8 21	2.4 3.2	1.0 1.5	.1 .1	.2 .3	c/20 c/31	0 0	22 44	7.0 7.2	8 8
16	Blue Creek near Oakman, Ala.	Aug. 30	.07	...	...	2.8	1.9	28	a/11	...	...	44	28	5	65	7.0	3
17	Hurricane Creek near Holt, Ala.	Apr. 29 Aug. 29	52 17	...	...	...	...	2 2	...	...	...	53	26	24	78	6.1	4
			...	...	6.8	7.5	1.5	2	48	1.8	.2	.2	c/ 77	46	129	5.1	0
18	North River near Berry, Ala.	Apr. 29	.....	7.5	.10	1.7	.8	13	2.8	1.5	.0	.2	c/ 24	0	30	7.3	4
19	Turkey Creek near Tuscaloosa, Ala.	Aug. 30	.....	...	...	1.1	.4	7	a/ 3.8	...	...	12	7	2	17	6.7	22

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved solids ^b / _c	Hardness as CaCO3		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
BLACK WARRIOR RIVER BASIN --Continued 1960																				
20	Binnion Creek near Samantha, Ala.	Aug. 30	.....	...	...	...	...	1.4	1.1	10	a/ 4.6	...	...	...	17	9	1	25	6.9	23
21	North River near Tuscaloosa, Ala.	Aug. 30	100	7.9	0.06	2.0	1.2	1.7	1.2	11	2.8	1.2	0.2	0.2	c/ 24	10	1	31	6.8	5
22	Black Warrior River at Tuscaloosa, Ala.	Apr. 30	4,310	5.6	...	10	2.4	8.1	1.5	24	28	3.1	.2	1.8	c/ 73	35	16	125	7.3	4
		Aug. 30	751	3.2	.01	26	.5	19	2.2	49	62	5.8	.3	1.4	c/ 144	67	27	211	7.0	3
23	Black Warrior River at Fosters Ferry Bridge, Ala.	Sept. 1	.....	3.0	.34	13	4.7	15	2.4	36	44	4.5	.2	.3	c/ 101	52	22	184	6.6	4
24	Big Sandy Creek at Duncanville, Ala.	Aug. 28	32	...	...	...	...	1.3	1.1	94	a/ 5.4	...	...	...	104	79	2	153	7.8	3
25	Big Sandy Creek near Moundville, Ala.	Aug. 31	.....	...	...	...	...	1.1	.8	55	a/ 4.6	...	...	...	65	47	2	95	7.7	8
26	Grant Creek near Fosters, Ala.	Sept. 1	.....	...	...	...	...	1.3	.6	11	a/ 2.5	...	...	...	14	8	0	21	6.7	22
27	Elliot Creek at Moundville, Ala.	Aug. 31	e/ 11	...	...	...	...	1.3	.7	16	a/ .8	...	...	...	15	10	0	22	7.2	12
28	Back Creek near Ralph, Ala.	Sept. 1	.....	...	...	...	...	1.8	1.6	12	a/ 5.0	...	...	...	20	10	0	29	6.8	8
29	Gabriel Creek near Moundville, Ala.	Aug. 31	.....	...	...	...	...	...	...	12	...	...	...	...	175	6	0	257	7.0	27
30	Sims Creek near Knoxville, Ala.	Sept. 1	.....	...	...	...	...	2.1	1.9	29	a/ 1.7	...	...	...	34	19	0	50	7.6	2
31	Davis Creek near Knoxville, Ala.	Sept. 1	.....	...	...	...	...	2.7	1.9	29	a/ 5.4	...	...	...	41	22	0	60	7.2	4
32	Fivemile Creek near Greensboro, Ala.	Aug. 31	e/ 6.0	...	...	...	...	1.3	1.3	12	a/ 4.6	...	...	...	22	11	1	32	6.9	22
33	Minter Creek near Eutaw, Ala.	Sept. 1	.....	...	...	...	...	3.4	2.2	53	a/ 7.5	...	...	...	69	42	0	102	7.4	3
34	Big Brush Creek near Greensboro, Ala.	Aug. 31	.....	...	...	...	...	1.9	2.1	21	a/ 5.4	...	...	...	32	17	0	47	7.4	4
35	Black Warrior River near Eutaw, Ala.	Apr. 30	.....	8.1	.07	8.2	2.9	7.3	1.7	22	22	6.0	.1	1.7	c/ 69	32	14	117	7.4	3
		Sept. 1	.....	3.6	.01	12	4.4	16	2.1	32	38	10	.3	1.0	c/ 103	48	22	184	6.9	5
36	Prairie Creek near Gallion Ala.	Aug. 31	.....	...	...	...	...	>10	3.2	128	...	...	...	...	168	104	0	247	8.2	3
37	Little Prairie Creek near Cedarville, Ala.	Aug. 31	.....	...	...	...	...	>10	4.7	160	...	...	...	...	197	114	0	289	7.9	3

Table 10. --Chemical analyses of selected streams--Continued

Station number	Station location	Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids $\frac{b}{l}$	Hardness as CaCO ₃		Specific conductance (micromhos at 25°C)	pH	Color
																Calcium, Magnesium	Non-Carbonate			
TENNESSEE RIVER BASIN--Continued																				
3	Kirby Creek near Section, Ala.	1960 Aug. 31	.....	...	...	...	...	3.2	1.8	17	a/88	...	...	...	32	15	1	47	6.8	8
4	South Sauty Creek near Rainsville, Ala.	Apr. 26 Aug. 31	.....	...	...	...	...	...	...	17 14	... a/11	...	...	...	27 31	10 14	0 2	40 45	6.5 6.8	3 7
5	Town Creek near Geraldine, Ala.	Apr. 26 Aug. 31	129 3.5	3.9 2.1	0.08 .04	2.5 3.6	0.5 .6	2.7 2.8	.9 2.0	6 15	3.2 4.8	3.5 3.8	0.0 .1	1.4 .2	c/22 c/27	8 12	3 0	34 40	6.0 6.4	3 3
6	Short Creek near Albertville, Ala.	Apr. 26	.....	4.1	.04	3.0	.6	3.5	.9	9	2.8	4.0	.0	2.2	c/26	10	2	41	6.2	4
7	Scarham Creek near Crossville, Ala.	Aug. 31	.....	3.1	.18	3.4	.6	3.7	1.5	16	4.4	4.2	.1	.1	c/29	11	0	43	6.7	4
8	Tennessee River at Guntersville, Ala.	Sept. 1	.....	...	...	...	...	7.0	1.2	68	a/28	...	...	...	103	72	16	180	7.8	2
9	Paint Rock River near Woodville, Ala.	Apr. 26 Aug. 31	.....	4.5 7.0	.10 ...	42 50	3.0 4.0	1.0 1.4	.5 .3	136 162	6.0 9.2	1.0 2.8	.1 .2	.1 1.5	c/125 c/156	118 142	6 8	230 263	7.4 7.1	2 3
10	Hurricane Creek near Huntsville, Ala.	Aug. 31	.....	...	...	...	...	1.5	.7	166	a/12	...	...	...	172	146	10	276	7.9	3
11	Flint River near Huntsville, Ala.	Aug. 31	e/ 130	...	...	...	...	1.1	.6	69	a/ 5.8	...	...	...	71	60	4	118	7.4	4
12	Tennessee River at Whitesburg, Ala.	Sept. 1	.....	5.8	.02	23	3.4	6.2	.9	67	16	12	.2	.0	c/100	72	16	175	7.1	3
13	Indian Creek near Huntsville, Ala.	Aug. 31	.....	7.3	.10	23	3.0	1.0	.1	83	.8	3.2	.1	1.5	c/ 81	70	2	134	7.2	2
14	Indian Creek near Madison, Ala.	Apr. 27	32	1.2	.02	28	1.8	1.4	.6	87	2.0	2.0	.0	1.1	c/ 81	78	6	156	7.3	3
15	Cotaco Creek near Somerville, Ala.	Sept. 1	.....	...	...	...	...	2.5	1.1	90	a/ 6.7	...	...	...	94	75	1	157	8.0	3
16	Limestone Creek near Athens, Ala.	Aug. 31	.....	7.5	.00	13	.9	.9	.5	41	2.4	1.5	.1	.7	c/ 48	36	2	72	7.2	4
17	Limestone Creek at Mooresville, Ala.	Apr. 27	.....	...	...	...	...	...	...	30	...	...	...	...	41	28	4	68	7.2	4
18	Piney Creek near Athens, Ala.	Aug. 31 Sept. 1	e/ 2 e/ 2	...	...	...	...	1.0 .8	.9 .8	38 36	a/ 5.0 2.8	...	...	...	40 c/ 41	34 29	3 0	67 63	7.6 7.1	3 3
19	Piney Creek at Athens, Ala.	Apr. 27	.....	6.2	.02	7.0	1.5	1.0	1.0	30	2.4	2.0	.0	1.9	c/ 38	24	0	58	7.5	4
20	Flint Creek near Cullman, Ala.	Apr. 28	.....	...	...	...	...	...	...	73	...	...	...	...	65	45	0	108	7.5	4

21	Flint Creek near Hartselle, Ala.	Sept. 1	.....	6.5	.00	34	2.4	3.8	1.1	110	7.2	5.2	.2	1.1	c/116	95	5	196	7.0	3
22	West Fork Flint Creek near Danville, Ala.	Sept. 1	.....	...	...	...	...	1.8	.8	d/205	a/ 1.3	...	...	...	188	165	20	313	8.3	3
23	Tennessee River at Decatur, Ala.	Sept. 1	.....	5.7	.03	22	3.8	7.0	.7	62	15	13	.2	.6	c/ 99	70	20	165	6.9	2
24	Swan Creek near Athens, Ala.	Aug. 31	.....	...	...	...	...	>10	4.6	74	...	...	...	...	124	73	12	218	7.5	3
25	Swan Creek near Tanner, Ala.	Sept. 1	.....	...	...	...	...	1.9	1.4	60	a/ 5.8	...	...	...	64	50	1	106	7.4	3
26	Fox Creek near Decatur, Ala.	Sept. 1	.....	3.8	.04	34	1.5	2.5	1.8	104	8.8	3.8	.2	1.8	c/109	91	6	178	7.2	4
27	Elk River near Athens, Ala.	Apr. 27 Sept. 1	..... .....	2.7 6.0	.04 .01	33 36	3.6 1.2	1.2 2.0	.7 .8	106 108	7.2 8.8	1.5 3.0	.2 .2	2.3 .5	c/104 c/112	98 95	10 6	192 195	7.9 7.2	1 3
28	Sulfur Creek near Elkmont, Ala.	Apr. 27	.....	...	...	...	...	...	...	94	...	...	...	...	110	85	18	183	7.6	4
29	Anderson Creek at Anderson, Ala.	Sept. 1	.....	7.1	.12	17	2.1	1.1	.1	60	2.4	2.2	.2	1.3	c/ 64	51	2	101	6.9	2
30	Bluewater Creek near Elgin, Ala.	Sept. 1	.....	...	...	...	...	1.0	.8	63	a/ 4.6	...	...	...	64	54	2	106	7.6	4
31	Tennessee River at Florence, Ala.	Apr. 28 Sept. 1	..... .....	3.1 4.7	02	20 20	1.8 4.0	3.1 7.3	.8 .7	60 61	10 15	5.0 14	.1 .3	.2 .0	c/ 74 c/ 96	58 66	8 16	134 165	6.9 7.1	3 3
32	Cypress Creek near Cloverdale, Ala.	Sept. 1	.....	7.0	.11	8.2	.7	1.1	.2	27	2.8	2.8	.1	.0	c/ 36	24	2	52	6.6	2
33	Middle Cypress Creek near Cloverdale, Ala.	Sept. 1	.....	...	...	...	...	1.2	.6	60	a/ 2.9	...	...	...	61	49	0	102	7.3	3
34	Little Cypress Creek near Florence, Ala.	Sept. 1	.....	...	...	...	...	.8	.4	62	a/ 1.7	...	...	...	61	51	0	102	7.7	3
35	Spring Creek near Muscle Shoals, Ala.	Apr. 28	.....	7.4	.07	38	1.5	2.4	.7	117	7.2	3.2	.1	1.1	c/120	101	5	210	7.9	3
36	Tennessee River at Waterloo, Ala.	Apr. 27	.....	2.5	.04	20	2.4	3.1	.7	59	10	4.2	.1	1.2	c/ 73	60	12	135	7.1	3
37	Bear Creek near Haleyville, Ala.	Aug. 30	.....	6.4	.14	3.2	1.6	1.2	1.7	16	1.6	5.0	.0	.1	c/ 29	14	2	34	6.6	4
38	Bear Creek near Bear Creek, Ala.	Aug. 30	.....	5.5	.03	2.6	.7	1.1	.9	12	1.2	3.8	.0	.0	c/ 22	10	0	25	6.7	3
39	Bear Creek near Hackleburg, Ala.	Apr. 28	130	5.3	.00	1.8	.4	1.7	8	6	2.0	2.0	.0	.5	c/ 18	6	1	24	6.0	3
40	Bear Creek near Vina, Ala.	Aug. 30	.....	...	...	...	...	1.4	1.3	22	a/ 4.6	...	...	...	40	19	1	44	7.2	4
41	Cedar Creek near Russellville, Ala.	Apr. 28 Sept. 1	..... .....	5.9 6.5	.03 .00	46 57	1.1 1.0	1.6 3.2	.9 .8	140 173	4.4 7.2	2.5 3.8	.1 .1	.1 .0	c/132 c/165	120 146	5 4	240 282	7.2 7.2	3 2
42	Lick Creek near Belgreen, Ala.	Sept. 1	.....	...	...	...	...	1.0	...	150	...	...	...	...	142	123	0	236	8.1	3
43	Little Bear Creek near Belgreen, Ala.	Apr. 28	.....	...	...	...	...	...	...	8	...	...	...	...	38	15	8	44	6.8	3
44	Little Bear Creek near Dempsey, Ala.	Sept. 1	.....	...	...	...	...	1.5	1.0	101	a/ 4.2	...	...	...	99	83	0	165	7.9	3

a/ Parts per million SO₄ + Cl = EPM cations - EPM bicarbonate x 41.7
b/ Sum of mineral constituents in ppm = specific conductance x factor (factor determined by areas)
c/ Calculated from determined constituents
d/ Equivalent of 14 parts per million carbonate (CO₃)
e/ Estimated

APPENDIX

EXPLANATION OF TERMS

Characteristics of water quality.--Distinguishing features of water imparted by the number, kind, and amount of organic or inorganic materials.

Color.--The color of water as considered in this report is that due to substances in solution. Color in water may be of mineral, animal, or vegetable origin. It may be caused by metallic substances, humus materials, peat, algae, weeds, or protozoa. Industrial wastes may also color water. The color of water is compared to that of glass-colored discs which have been calibrated to correspond to the platinum-cobalt scale of Hazen.

Dissolved solids.--The reported quantity of dissolved solids--the residue on evaporation--consists primarily of the dissolved mineral constituents in the water. The residue on evaporation may also contain organic matter and water of crystallization. Water with less than 500 ppm of dissolved solids is usually satisfactory for domestic and most industrial uses.

Dissolved ions.--The positive or negative charged atoms or group of atoms formed when materials dissolve in water. Anions are those ions which carry the negative charge of electricity and deposit on the anode in an electrical cell. In water the anions are the non-metallic ions. Those determined for this study include carbonate, bicarbonate, sulfate, chloride, fluoride, and nitrate. Cations are the positively charged ions that deposit on the cathode of an electrical cell. Those cations determined for this study include calcium, magnesium, sodium, and potassium.

Equivalent.--A term used in chemistry to denote equal combining power. It is the weight in grams of an element that will combine with one weight of hydrogen. The equivalent weight of an element is the atomic weight divided by its valence in a particular reaction. Thus 23 grams of sodium, one equivalent weight, will combine with 35.5 grams, one equivalent weight, of chloride to form 58.5 grams of sodium chloride (common table salt).

Equivalents per million as reported in this report are numerical expressions of parts per million. The equivalents per million are computed by multiplying the reported concentration of the individual constituents in parts per million by the reciprocal of their combining weight.

A percentage equivalent is a value obtained by dividing the equivalents per million of the particular anion or cation by the summation of the equivalents per million of all of the anions or cations.

Hardness.--The property of water attributable to the presence of alkaline earths such as calcium and magnesium. Hardness represents the soap-consuming power of water (Hem, 1959, p. 145).

Hydrogen-ion concentration.--The degree of acidity or alkalinity of water is indicated by the hydrogen-ion concentration, expressed as pH. The pH values range from 0 to 14 and are the negative logarithm of the hydrogen-ion concentration in moles per liter of solution. The pH is necessary for evaluation of the suitability of water for various industrial uses, treatment necessary for clarification of the water, and evaluating the corrosiveness of the water. A pH value of 7.0 indicates that the water is at its neutral point, being neither acidic nor alkaline. Values progressively lower than 7.0 denote increasing acidity, whereas values progressively higher than 7.0 denote increasing alkalinity.

Mineral content.--A calculated value obtained by summation of the quantities, in parts per million, of the individual constituents dissolved in water. In this report the value usually includes silica, iron, calcium, magnesium, sodium, potassium, bicarbonate (as carbonate), sulfate, chloride, fluoride, and nitrate.

Parts per million (ppm).--The dissolved chemical constituents are reported in parts per million. A part per million is a unit weight of a constituent in a million unit weights of water plus constituents.

Specific conductance.--Specific conductance is the measure of the capacity of water to conduct an electric current. It varies with the concentration and degree of ionization of the different constituents in solution. It may be used to estimate the mineral content but does not indicate the nature of or the relative amounts of the various mineral constituents.

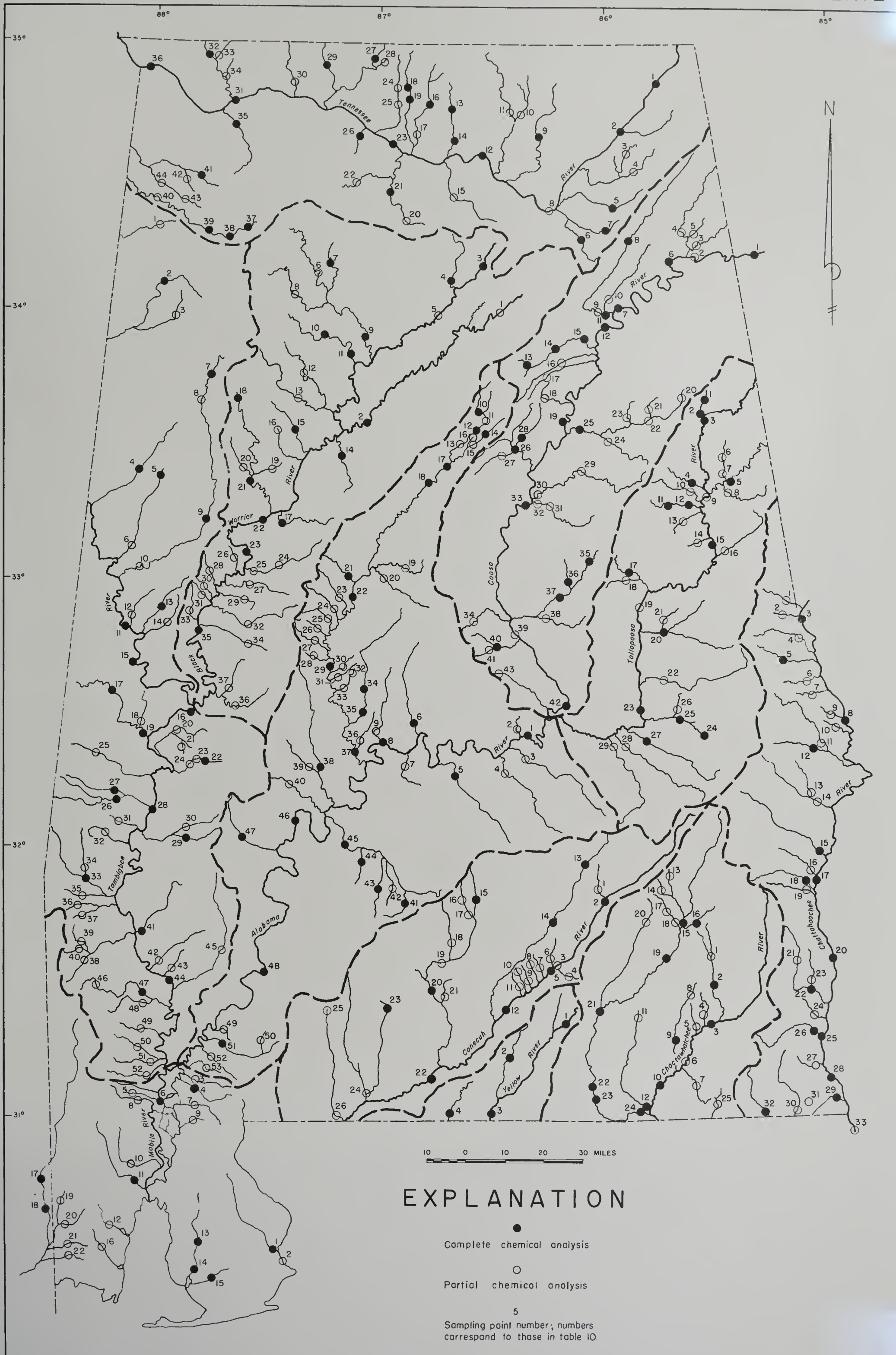


PLATE I. LOCATION OF SAMPLING POINTS ON STREAMS IN ALABAMA, 1960

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